STAR

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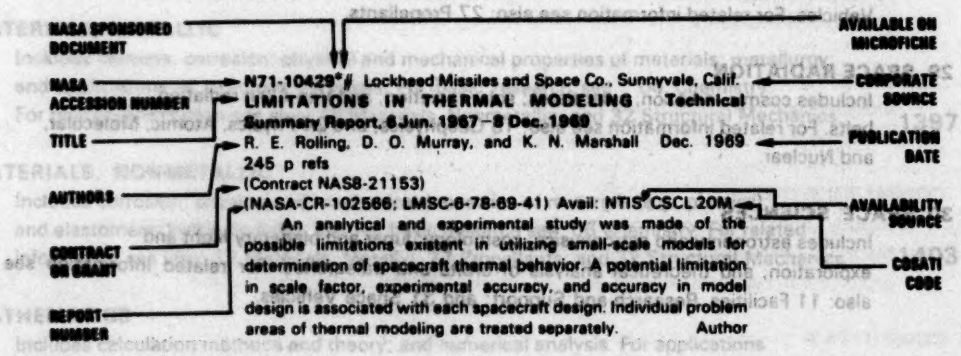
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R. E. Rolling, D. O. Murray, and K. N. Marshall Dec. 1969
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CODATI CODE
An analytical and experimental study was made of the possible limitations existent in utilizing small-scale models for determination of spacecraft thermal behavior. A potential limitation in scale factor, experimental accuracy, and accuracy in model design is associated with each spacecraft design. Individual problem areas of thermal modeling are treated separately. Author

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Scientific and Technical Aerospace Reports

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N71-19353# Advisory Group for Aerospace Research and Development, Paris (France).

AERODYNAMIC INTERFERENCE

Jan. 1971 451 p refs Presented at Fluid Dyn. Panel Specialists' Meeting, Silver Spring, Md., 28–30 Sep. 1970

(AGARD-CP-71-71) Avail: NTIS HC$6.00/MF$0.95

Aerodynamic interference characteristics of various airframe-propulsion systems for commercial transport and military aircraft are discussed. Wing-fuselage store designs and body-wing and tail configuration effects are emphasized. For individual titles see N71-19354 through N71-19388.

N71-19354# Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

SOME REMARKS ON THE INTERFERENCE BETWEEN A SWEPT WING AND A FUSELAGE

D. Kuechemann *In* AGARD Aerodyn. Interference Jan. 1971 11 p refs (See N71-19353 09-01)

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Principal physical interference effects which occur when a swept (or unswept) wing is joined to a fuselage are analyzed. The flow is dominated by what happens in the junction between the two bodies; here the interference is largest. The leading terms in the velocity field can be interpreted as being caused in part by the interference with the mirror image in a plane wall of the half wing outside the fuselage. This reflection effect depends mainly on the sweep angle and the dihedral angle. In addition, there is a body interference effect at all sweep and dihedral angles. The method of singularities is applied to calculate the inviscid flow field for some simple cases with and without lift. Theoretical and experimental results demonstrate quite clearly the magnitude of the interference effect. Author

N71-19355# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).

WIND TUNNEL INVESTIGATION OF THE VORTEX SYSTEM NEAR AN INCLINED BODY OF REVOLUTION WITH AND WITHOUT WINGS

F.-R. Grosche *In* AGARD Aerodyn. Interference Jan. 1971 15 p refs (See N71-19353 09-01)

Avail: NTIS HC$6.00/MF$0.95

The flow field on the suction side of a slender body of revolution with and without wings was investigated by means of a directional probe in a 3 m x 3 m low speed wind tunnel. Measurements have been conducted at Mach numbers Ma = 0.12 and Reynolds numbers Re = 500,000, based on free stream velocity and body diameter. The model was tested at angles of attack alpha = 7 deg, 10 deg, 15 deg, 20 deg. From the measured data, the cross flow velocities and the isobars of total pressure loss were computed. Position and strength of the vortices were determined as functions of the axial coordinate. There are significant deviations from the results of measurements at high subsonic or supersonic velocities, as well as from measurements at substantially lower Reynolds numbers. The strength of the body vortices is considerably reduced by the presence of the wings. Author

N71-19356# Boeing Co., Seattle, Wash. SST Aerodynamics Configuration Group.

CONSIDERATIONS OF AERODYNAMIC INTERFERENCE IN SUPERSONIC AIRPLANE DESIGN

Edward J. Kane and Wilbur D. Middleton *In* AGARD Aerodyn. Interference Jan. 1971 16 p refs (See N71-19353 09-01)

Avail: NTIS HC$6.00/MF$0.95

Methods for optimizing the interferences between aircraft wing and body, wing and engine nacelles, and wing and trimming surfaces in supersonic flow are discussed. Theoretical concepts are reviewed and expanded where necessary to understand the physical relationship that leads to the most favorable arrangement of the configuration components. Specific applications are illustrated by examples employing analyses of both theoretical and experimental data. Author

N71-19357*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

RECENT EXPERIENCE IN USING FINITE ELEMENT METHODS FOR THE SOLUTION OF PROBLEMS IN AERODYNAMIC INTERFERENCE

Ralph L. Carmichael *In* AGARD Aerodyn. Interference Jan. 1971 5 p refs (See N71-19353 09-01)

(NASA-TM-X-66884) Avail: NTIS CSCL 20D

Discrete sets of elementary solutions of the linearized equations of gas dynamics for solving problems of flow about airplane configurations are combined in such a way that the boundary conditions of zero flow through physical surfaces are satisfied at large numbers of control points on the surfaces. Calculations using discrete elements and discrete control points produce solutions consistent with closed-form solutions that satisfy the boundary conditions everywhere. An existing computer program for predicting the flow about simple wing-body combinations is expanded to include bodies other than the main fuselage. Author

N71-19358# National Physical Lab., Teddington (England). Aerodynamics Div.

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF WING BODY CONFIGURATIONS AT LOW SUPERSONIC SPEEDS

J. Bridgewater, R. C. Lock, and G. F. Lee *In* AGARD Aerodyn. Interference Jan. 1971 11 p refs (See N71-19353 09-01)

Avail: NTIS HC$6.00/MF$0.95

Wing-body combinations with modifications to the shapes of the basic bodies, wing leading edges and wing roots for reduced drag at transonic and low supersonic speeds were studied. Force and pressure measurements are given for a 55 deg swept wing mounted in turn on two asymmetrically waisted bodies. The first body was designed with the aid of the transonic area rule, and the second was a modified version of this design to give improved performance at low supersonic speeds. Additional experimental results are presented for a second wing having a much blunter leading edge shape so as to give a peaky type of pressure distribution in place of the roof-top pressure distribution of the first wing. Finally considered is the blending of varying wing section shapes near the root of swept wings at supersonic speeds in order to achieve a favorable combined wing-body pressure field inboard on the wind, thus offering the possibility of drag reduction without the use of body waisting. Author

N71-19359# Technische Hogeschool, Delft (Netherlands).

LIFT AND DRAG CHARACTERISTICS OF DELTA WING HALF CONE CONFIGURATIONS WITH SUBSONIC LEADING EDGES, USING SLENDER BODY THEORY

W. J. Bannink and J. W. Reyn *In* AGARD Aerodyn. Interference Jan. 1971 11 p refs (See N71-19353 09-01)

Avail: NTIS HC$6.00/MF$0.95

Configurations composed of a cone with a half-circular cross section mounted asymmetrically with respect to a delta wing of zero thickness with subsonic leading edges and placed in a supersonic flow, are studied using slender body theory. The lift and drag characteristics are compared to those of configurations having an identical wing and a symmetrically disposed circular cone of equal volume as the half cone. A disposition of a half cone on one side of the delta wing shows a drag reduction at a given lift compared to the symmetrical full cone configuration, provided the body diameter-wing span ratio is larger than 0.45 approximately. However, the high wing disposition is preferable to the low wing, since lower angles of incidence are required to attain a certain lift. Below the ratio of 0.45 the symmetrical system appears to be more favorable. The lift curve slopes of asymmetrical configurations studied are larger than those of symmetrical configurations. Author

N71-19360# Messerschmitt-Boelkow G.m.b.H., Munich (West Germany).

DOWNWASH INVESTIGATIONS ON TAILS OF MISSILES

G. Gregoriou and J. Laüde (DFVLR, Brunswick, West Germany) *In* AGARD Aerodyn. Interference Jan. 1971 14 p refs (See N71-19353 09-01)

Avail: NTIS HC$6.00/MF$0.95

A numerical method was developed to calculate the downwash and hence the forces and moments on missile tails. This method is principally based on the linear lifting surface theory and can be applied in the compressible subsonic range at any angle of attack and bank. The results of the calculation indicate a nonlinear dependence of the average downwash angle on the angle of attack. Generally, theoretical results show good agreement with wind tunnel tests. Author

N71-19361*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXTENSION OF A NUMERICAL SOLUTION FOR THE AERODYNAMIC CHARACTERISTICS OF A WING TO INCLUDE A CANARD OR HORIZONTAL TAIL

Barrett L. Shrout *In* AGARD Aerodyn. Interference Jan. 1971 12 p refs (See N71-19353 09-01)

(NASA-TM-X-66886) Avail: NTIS CSCL 20D

A method for predicting the aerodynamic lifting surface characteristics of wing-horizontal tail configurations or canard wing configurations at supersonic speeds is discussed. The numerical solution has been programmed for a digital computer and is part of a complex of computer programs used in the design, optimization, and evaluation of aircraft configurations at supersonic speeds. The present method predicts lift, drag, and moment characteristics over a range of lift coefficients and for various control settings. Theoretical and experimental data are compared for wing-horizontal tail configurations and for canard-wing configurations at various Mach numbers. These comparisons show both the basic data with control deflections and some final trimmed drag polars. Some data are also presented to show the extent to which program limitations affect the accuracy of the analytic methods. Author

N71-19362# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

CALCULATION OF AERODYNAMIC INTERACTIONS BETWEEN LIFTING ELEMENTS OF AN AIRPLANE IN SUPERSONIC STATIONARY OR NONSTATIONARY FLOW [CALCUL D'INTERACTIONS AERODYNAMIQUES ENTRE LES ELEMENTS PORTANTS D'UN AVION EN ECOULEMENT SUPERSONIQUE STATIONNAIRE OU INSTATIONNAIRE]

Michel Enselme, Jean-Paul Boisseau, and Andre Guillois *In* AGARD Aerodyn. Interference Jan. 1971 7 p refs In FRENCH; ENGLISH summary (See N71-19353 09-01)

Avail: NTIS HC$6.00/MF$0.95

After recalling the principle of analog computation of a lifting assembly in supersonic, steady or unsteady flow a numerical process is presented that uses an explicit method for computing the solutions of the wave equation. Results obtained either by analog or by numerical computations are presented for wing-body or wing-pod interactions, and for a wing of arbitrary planform in unsteady flow. Author

N71-19363# Naval Ship Research and Development Center, Washington, D.C.

THE EFFECT OF ANGLE OF ATTACK ON INDUCED ROLLING MOMENT FOR A LOW ASPECT RATIO MISSILE

Raymond P. Le Beau *In* AGARD Aerodyn. Interference Jan. 1971 11 p refs (See N71-19353 09-01)

Avail: NTIS HC$6.00/MF$0.95

Two wind tunnel tests were conducted to examine the characteristics of the induced rolling moment of two small span missile configurations at transonic Mach numbers for angles of attack up to 90 deg. The induced rolling moment at a roll angle of 22.5 deg was found to increase with angle of attack to a peak value then remain near that value to 90 deg. This peak occurred at angles between 25 deg and 40 deg. It was also observed that negative values of induced rolling moment at a roll angle of 22.5 deg occurred for one configuration when the angle of attack was less than 20 deg. Author

N71-19364# National Aerospace Lab., Amsterdam (Netherlands). Dept. for Theoretical Aerodynamics.

AN APPROXIMATE METHOD FOR THE CALCULATION OF THE PRESSURE DISTRIBUTION ON WING BODY COMBINATIONS AT SUBCRITICAL SPEEDS

Th. E. Labrujere, W. Loeve, and J. W. Slooff *In* AGARD Aerodyn. Interference Jan. 1971 17 p refs (See N71-19353 09-01)

Avail: NTIS HC$6.00/MF$0.95

A method is described which makes it possible to calculate accurate pressure distributions on lifting configurations at Mach

numbers up to the critical value. The compressible flow around a configuration is related to an incompressible flow by means of Goethert's rule, which is supplemented semi-empirically. The iterative scheme for solving the large system of linear, simultaneous equations that is involved with the incompressible flow problem is optimized. Assuming a simple wake configuration, the method has been applied to a number of lifting wing-body combinations. Comparisons with measured pressure distributions show that the method can be used when studying wing-body interference problems in subcritical, attached flow. Author

N71-19365# Naval Ordnance Lab., White Oak, Md.
AERODYNAMIC INTERACTION PHENOMENA PRODUCED BY A FIN PROTUBERANCE PARTIALLY IMMERSED IN A TURBULENT BOUNDARY LAYER AT MACH 5
Allen E. Winkelmann *In* AGARD Aerodyn. Interference Jan. 1971 12 p refs (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

Various flow visualization results are presented for a cylindrically blunted, unswept, unyawed fin partially immersed in a turbulent boundary layer. The model, consisting of a fin-flat plate combination, was mounted on the test plate nozzle wall of a boundary layer channel. Experiments were completed at a nominal Mach number of 5 and nominal free-stream Reynolds numbers per foot of 2.8 x 1 million and 7.4 x 1 million. Azobenzene tests show regions of high heat transfer to occur on the flat plate immediately upstream and downstream of the fin. Oil smear tests show in detail the surface shear directions and locations of separated flow which occur on the model. Schlieren and shadowgraph photographs indicate the complex shock wave structure which exists in front of the fin. Author

N71-19366*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLIGHT AND WIND TUNNEL INVESTIGATION OF INSTALLATION EFFECTS ON UNDERWING SUPERSONIC CRUISE EXHAUST NOZZLES AT TRANSONIC SPEEDS
Daniel C. Mikkelsen and Bernard J. Blaha *In* AGARD Aerodyn. Interference Jan. 1971 10 p refs (See N71-19353 09-01)
(NASA-TM-X-68687) Avail: NTIS CSCL 20D

A combined flight and wind tunnel test program is being conducted utilizing a modified F-106 aircraft, to investigate airframe installation effects on exhaust nozzle systems mounted on underwing engine nacelles. Flight tests in the transonic speed regime determined nozzle performance and boattail drag for variable flap ejector, conical plug, and auxiliary inlet ejector nozzle concepts. Wind tunnel tests were conducted on isolated models of these nozzles and also on a 1/20-scale model of the F-106 aircraft with simulated underwing engine nacelles. Wing and nacelle pressures from these wind tunnel tests are used to qualitatively explain the observed installation effects. The 1/20-scale model was also used to evaluate the effects of changes in nacelle geometry and angle-of-attack. Author

N71-19368*# National Aeronautics and Space Administration. Langley Research Center, Langley, Va.
AERODYNAMIC INTERFERENCE BETWEEN EXHAUST SYSTEM AND AIRFRAME
Jack F. Runckel *In* AGARD Aerodyn. Interference Jan. 1971 13 p refs (See N71-19353 09-01)
(NASA-TM-X-68688) Avail: NTIS CSCL 01A

Mutual aircraft afterbody and engine nozzle interferences are studied by a model experimental investigations of jet interference at subsonic, transonic, and supersonic speeds. Emphasis is placed on twin-engine fuselage configurations with nozzles installed near the terminus of the afterbody where the interactions of the nozzle exhausts and the external stream produce a complex flow field environment. Airframe interferences on nozzle performance considered are: installation locations in the afterbody, boattailing ahead of the nozzles, and effects of tails and protuberances. Nozzle shape and jet exhaust interference can alter aircraft performance and stability. The effect on afterbody drag of nozzle exit axial location appears to pose more problems than the lateral spacing of the nozzles. For closely spaced nozzles, the shape of the interfairing between the nozzles has a pronounced effect on afterbody and nozzle performance. Author

N71-19370# Tennessee Univ., Tullahoma. Space Inst.
UNSTEADY AERODYNAMICS OF ROTOR BLADES OF A COMPRESSOR UNDER DISTORTED FLOW CONDITIONS
B. H. Goethert and K. C. Reddy *In* AGARD Aerodyn. Interference Jan. 1971 13 p refs (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

A theoretical investigation was undertaken to determine the interference effect between oscillating and distorted inlet flow and compressor stall. It was found that the dynamic effects on the single stage characteristics tend to make the stages less sensitive to pressure oscillations since the flow lacks the necessary time for building up the lift of the individual blades of the stage. On the other hand, the spacer volume in the stages themselves and between the stages produce time lags which tend to increase the stage pressure ratio and thus reduce the stall margin of the individual stages. Depending upon the geometry and the type of oscillations, either the beneficial effects of the dynamic response reduction of individual stages at higher frequencies or the detrimental effects of the spacer volume between the stages will prevail. Author

N71-19371*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
STUDIES OF AIRCRAFT FLOW FIELDS AT INLET LOCATIONS
Lyndell S. King and Terence W. Schmidt (Arnold Res. Organ., Inc.) *In* AGARD Aerodyn. Interference Jan. 1970 10 p refs (See N71-19353 09-01)
(NASA-TM-X-68685) Avail: NTIS CSCL 20D

A wind-tunnel investigation of the flow fields about fuselage configurations at transonic and supersonic speeds and at angles of attack up to 24 deg is reported. A family of seven fuselages with different cross sectional shapes was tested in conjunction with two nose shapes, two canopies, and two wings of different sweep. Flow field surveys were performed at two likely inlet locations – ahead of and under the wing – to assess the effects of forebody geometry throughout the Mach number and angle-of-attack envelope. The experimental data particularly indicate the strong influence of the canopy, nose droop, and fuselage shape on flow angularities in the forward survey plane. Nose droop and the canopy both tend to reduce sensitivity to positive angles of attack and to reduce the extent of influence of fuselage lower corner geometry. Under the wing, however, the flow field is dominated by the effects of the wing itself. Author

N71-19372# National Gas Turbine Establishment, Pyestock (England).
SOME RECENT RESEARCH ON SUPERSONIC INTAKES AT NGTE
M. C. Neale and F. W. Armstrong *In* AGARD Aerodyn. Interference Jan. 1971 18 p refs (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

Drag investigations covering both supersonic and subsonic flight conditions are described, and attention is focused on the difficulty of minimizing supersonic pre-entry drag while retaining an adequate stability margin. The effects are shown of shear planes of varying strength generated in the supersonic compression field. Reynolds number effects are also described. A brief survey of prospects for mixed compression intakes offering an optimum combination of drag and high pressure recovery in supersonic flight is included. Author

N71-19374# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).
JET SIMULATION AND JET INTERFERENCE EFFECTS ON TAILPLANE
W. Geissler and R. Wulf *In* AGARD Aerodyn. Interference Jan. 1971 12 p refs (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

Extensive wind tunnel tests with jet simulation have been carried out in the low speed wind tunnel on different models of the European airbus. Bypass engines able to simulate the correct ratios of jet to freestream velocity have been developed and are described. The results of force and downwash measurements show destabilizing influences of the airplane caused by jet-tailplane interference. Several steps have been undertaken in order to minimize these effects: the displacement of the engines in wing-tip direction seemed to be the best solution of this problem. In addition to force measurements on a complete model the determination of magnitude and direction of the flow velocities established the boundaries of jet influence. Author

N71-19375# British Aircraft Corp., Weybridge (England). Aerodynamics Dept.
THE COMPLEX AERODYNAMIC INTERFERENCE PATTERN DUE TO REAR FUSELAGE MOUNTED POWERPLANTS
P. R. G. Williams and D. J. Stewart *In* AGARD Aerodyn. Interference Jan. 1971 15 p ref (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

The complex interference effects due to rear fuselage mounted power plants on modern high subsonic aircraft are investigated. Results from wind tunnel and full scale flight tests obtained during design and development of BAC VC10 and 1-11 are discussed. Of particular interest are the favorable interference on the wing and comparisons between twin and four-engined configurations. The influences of changes in fuselage length, nacelle setting and rear fuselage shaping to reduce adverse pressure fields are illustrated. Typical pressure distributions and boundary layer traverses measured on the standard and super VC10 in flight are presented and comparisons are made with wind tunnel results. The data presented are evaluated for the probable mechanism of the complex interference forces set up by the presence of the power plants. Author

N71-19376# General Dynamics/Convair, San Diego, Calif.
EXPERIMENTAL RESULTS OF HIGH BYPASS RATIO TURBOFAN AND WING AERODYNAMIC INTERFERENCE
J. E. Aldridge and J. L. Nye (GE) *In* AGARD Aerodyn. Interference Jan. 1971 12 p (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

Results of a wind-tunnel investigation into the interference effects of a pylon-wing-mounted, high-bypass-ratio turbofan on the aerodynamic characteristics of a twin engine subsonic airplane are presented. This was accomplished using a high-pressure, air turbine powered propulsion simulator mounted on a 1/7-scale semispan model of the airplane. Results show that significant interference does exist, and that it varies with free stream Mach number, engine power setting, and lift coefficient. Generally, the drag due to nacelle/body interference increases with Mach number, decreases as engine power is increased, and optimizes with lift coefficient. The interference level is either favorable or unfavorable depending on these parameters. The presence of the nacelle has no measurable effect on wing upper surface pressure distribution; however, wing lower surface, nacelle fan, and turbine cowl distributions are significantly altered. Author

N71-19377# Douglas Aircraft Co., Inc., Santa Monica, Calif.
DETERMINATION OF LOW SPEED INTERFERENCE EFFECTS BY SUPERPOSITION
John L. Hess and Suzanne M. Faulkner *In* AGARD Aerodyn. Interference Jan. 1971 15 p refs (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

The application of a computer program for potential flow to problems of estimating aerodynamic interference is reported. Examples are presented of straightforward use of the program to calculate flow about more complicated configurations than could previously be handled. Superposition is also used to conserve computing time. The program greatly expands the usefulness of the superposition method. First, the component flows to be superposed may be any of the very general class of solutions that the program can calculate. Second, by comparing flows calculated by superposition with the same flows calculated exactly by the program, the limits of validity of the superposition principle can be determined with a new precision. Examples are presented of calculated flow fields and of comparisons of exact and superposed solutions. Author

N71-19378# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
WIND TUNNEL INVESTIGATION INTO AERODYNAMIC INTERACTIONS INDUCED BY DROP LOADS [ETUDE EN SOUFFLERIE DES INTERACTIONS AERODYNAMIQUES DUES AUX CHARGES LARGABLES]
J. Christophe and J. Coste *In* AGARD Aerodyn. Interference Jan. 1971 11 p refs In FRENCH; ENGLISH summary (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

Techniques for the investigation of aerodynamic interactions induced by drop loads are reviewed and some representative results are reported. Emphasis is placed on direct tracings of dropped load trajectories and microrocket propelled missiles by high speed filming in the wind tunnel. Obtained results are compared with those from the newly developed alternative method of weighing the load in the aerodynamic field of the aircraft and reconstructing its trajectory by computing routine. Author

N71-19386# Naval Ship Research and Development Center, Washington, D.C.
A STUDY OF CAPTIVE FLIGHT DRAG AND SEPARATION CHARACTERISTICS OF LIFTING BODY (HALF BOMB AND HALF POD) STORE CONFIGURATIONS
Roger J. Furey and C. Joseph Martin *In* AGARD Aerodyn. Interference Jan. 1971 11 p refs (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

The use of lifting bodies as a basic shape for externally carried stores is considered as a means of overcoming the large incremental drag and poor separation qualities of the more conventionally shaped aircraft stores. Wind-tunnel tests were conducted on a half-bomb and a half-pod to determine their captive flight drag and separation characteristics. Testing was conducted at Mach numbers of 0.74 and 1.88. The half-bombs were found to have as much as a 35 percent drag reduction, in a simulated captive flight condition, over its equivalent whole-bomb counterpart, and separated cleanly without the use of an ejection force under all conditions tested. The half-pod configuration produced as much as a 20 percent drag reduction over that of the equivalent whole-pod. It also separated cleanly although an ejection force was necessary in order to prevent a pitch-up maneuver and possible collision at the higher Mach number. Author

N71-19391# Aeronautical Research Labs., Melbourne (Australia).
THE EFFECT OF RELAXATION IN SCALING PARAMETERS ON THE FREE FLIGHT PATH OF A WIND TUNNEL MODEL WITH FORCED EJECTION
D. A. Lamaire and P. T. Malone Jun. 1970 24 p ref (ARL/A-322) Avail: NTIS

For the case of a nose strake ejected upstream of a body, the effect of certain relaxation of the basic similarity criteria on the

subsequent flight path of a scale model in a wind tunnel is considered. A scaling approximation based on (velocity) squared is derived and wind tunnel experiments to determine its validity are described. Comparative trajectories are also given for a specific model over a range of wind speeds, and it appears that considerable variation in test wind speed may be permissible if the full-scale density ratio is preserved. Author

N71-19548# Ballistic Research Labs., Aberdeen Proving Ground, Md.

AN EXPERIMENTAL INVESTIGATION OF THE SUPERSONIC TURBULENT BOUNDARY LAYER IN A MODERATE ADVERSE PRESSURE GRADIENT. PART 1: A DETAILED DESCRIPTION OF THE EXPERIMENT AND TABULATION

Walter B. Sturek Oct. 1970 131 p refs
(AD-716336; BRL-1506-Pt-1) Avail: NTIS CSCL 20/4

Experimental measurements of the profile characteristics of the supersonic turbulent boundary layer in a region of zero pressure gradient and in a region of moderate adverse pressure gradient along the curved surface of an isentropic ramp model are reported. Detailed surveys of impact pressure, static pressure and total temperature were taken through the boundary layer and local values of wall shear stress were obtained using the Preston tube technique. The measurements were made in a supersonic wind tunnel for a nominal tunnel nozzle setting of Mach 3.5. The data are for an adiabatic wall with values of momentum thickness Reynolds number ranging from 19,000 to 42,000. The experiment is described in detail and the mean profile data are presented in tabular form. Fluctuation data obtained using constant temperature hot wire anemometry are presented for one station in the region of zero pressure gradient and for one station in the region of adverse pressure gradient. Author (GRA)

N71-19558# Solar, San Diego, Calif.

ROTATING VANELESS DIFFUSER STUDY Final Report, Oct. 1969 – Sep. 1970

C. Rodgers and H. Mnew Ft. Belvoir, Va. Army Mobility Equipment Res. and Develop. Center Oct. 1970 82 p
(Contract DAAK02-70-C-0148)
(AD-716370; ER-2249) Avail: NTIS CSCL 20/4

An analytical and experimental investigation of the free vaneless rotating diffuser concept demonstrated both mechanical feasibility and aerodynamic effectiveness. The objectives of the program were to design, manufacture, and test a model rotating vaneless diffuser in a simulated compressor environment, to measure the performance gains, and to establish and verify an analytical design and performance method. The conclusions of the program are: (1) The free rotating vaneless space diffuser is mechanically feasible; (2) The free rotating vaneless space diffuser reduces diffusion losses by an amount depending on compressor pressure ratio and specific speed; (3) The analytical predictions of loss reduction were verified; (4) The exit traverse test results support the argument that the rotating diffuser will tend to smooth out distorted inlet flow profiles. Author (GRA)

N71-19559# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF ELASTICITY ON THE LIFTING FORCE OF A WING

B. S. Berkouskiy 30 Oct. 1970 10 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk Uk. SSR (Kiev), No. 11, 1967 p 1044 – 1048
(AD-716509; FTD-HC-23-1193-68) Avail: NTIS CSCL 1/1

A deformable bearing surface is of interest from the standpoint of designing rigid structures and obtaining controllable aerohydrodynamic characteristics. In the article static aerohydroelasticity is investigated. A general equation is considered for the deformation of the bearing surface in an ideal noncompressible infinite stream. The elastically deformed load-bearing surface is investigated by assuming that the theory for the large aspect ratio airfoil is applicable. An integral-differential equation is obtained for an elastic airfoil. The solution of this equation gives a dependence for the lift coefficient of a nondeformable airfoil and the function for the effect of elasticity. Author (GRA)

N71-19560# Fort Detrick, Frederick, Md. Munitions Development Div.

ON FLIGHT DYNAMICS OF MAGNUS ROTORS

Peter H. Zipfel (Ph.D. Thesis) Nov. 1970 285 p refs
(AD-716345; SMUFD-TR-117; AMXFD-AE-T-50403) Avail: NTIS CSCL 20/4

A Magnus rotor is an autorotating flight vehicle, designed to develop a Magnus force efficiently and to employ it as the major lift force in free flight. The equations of motion of Magnus rotors are derived and their performance and stability analyzed and correlated with free flight tests. Necessary and sufficient conditions for limit cycles are derived, and it is shown how limit cycles can be avoided by proper design of the Magnus rotor. Thirty models were flight tested. Their trajectories and attitude motions are correlated with computer simulations whose aerodynamic input data are solely based on wind tunnel tests. The agreement is satisfactory. Two different Magnus shapes were tested for limit cycles. The test results agree well with predictions. Author (GRA)

N71-19574# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PLASTIC WING WITH LAMINAR PROFILE

O. R. Cheranovskii et al 26 Aug. 1970 13 p refs Transl. into ENGLISH from Samoletostr. Tekh. Vozdush. Flota (USSR), no. 16, 1968 p 101 – 106
(AD-716526; FTD-HT-23-400-70) Avail: NTIS CSCL 1/3

A brief review is presented of the design and fabrication problems of plane and trapezoidal fiberglass wings with laminar profiles to be used in aerodynamic tests on an automatic airborne laboratory under real flight conditions. Techniques for manufacturing such plastic wings with required specifications and surface roughness and configuration allowances are described. The properties and fabrication of the wing rigging are discussed, and a version of a slotted plastic wing producing laminarization is described. A lower production cost, a simpler manufacturing technology, and higher aerodynamic properties are noted as the advantages of these plastic wings over riveted or wooden wings. Author (GRA)

N71-19706*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ESTIMATED AERODYNAMICS OF ALL-BODY HYPERSONIC AIRCRAFT CONFIGURATIONS

Louis J. Williams Washington Mar. 1971 38 p refs
(NASA-TM-X-2091; A-3637) Avail: NTIS CSCL 01C

Results are presented for aerodynamic performance, surface temperatures, and static longitudinal and directional stability. Aerodynamic performance of the all-body configurations is presented in the form of the effect on complete configuration maximum lift-to-drag ratio of Mach number, configuration geometry, and maximum allowable leading-edge temperature. Variations in the basic all-body shape were investigated using three independent shape parameters; body leading edge sweep, position of breakpoint between forebody and afterbody, and ratio of maximum cross section to body planform area. The third shape parameter had the strongest influence on the aerodynamic performance. Studies of the radiation equilibrium surface temperature show that the temperatures on the lower surface resulting from the inherent lift loading of the all-body configuration are less than would be expected for higher lift-loading configurations. A brief analysis of vehicle stability and control showed that using a canard for trim instead of horizontal fins reduced trim drag penalties. Author

N71-19707*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INLET PLENUM CHAMBER NOISE MEASUREMENT COMPARISON OF 20-INCH DIAMETER FAN ROTORS WITH ASPECT RATIOS 3.6 AND 6.6
Thomas F. Gelder and Richard F. Soltis Washington Mar. 1971 49 p refs
(NASA-TM-X-2191; E-5823) Avail: NTIS CSCL 01A

The effects of rotor blade aspect ratio, part-span damper design, and hub curvature on blade passing frequency noise, multiple pure-tone noise, and broadband noise from the inlet are presented for a wide range of speeds and airflow. Facility calibrations for noise are discussed and detailed radial aerodynamic measurements were made. The higher aspect ratio reduced the noise level of blade passing frequency for all speeds; about a 9 dB reduction at 70-percent speed to about a 14 dB reduction at 100-percent speed. The reduced size of dampers along with reduced hub curvature greatly improved the aerodynamic performance of the rotor with little change in blade passing-frequency noise levels. The other two noise components were about the same for all rotors. Author

N71-19709# Naval Ordnance Lab., White Oak, Md.
SUPERSONIC NOZZLE DESIGN
Stuart L. Brodsky 22 Sep. 1970 26 p refs
(AD-716026; NOLTR-70-131) Avail: NTIS CSCL 20/4

The paper is concerned with a method of finite differences for determining two-dimensional and axisymmetric supersonic nozzle contours. The approach taken is to specify a Mach number or velocity array along the entire centerline of the nozzle and then to integrate the equations numerically to obtain the desired nozzle shape. The original problem was tested in the subsonic region, and reasonable results were found provided the Mach number gradient was not too steep in a neighborhood of the sonic line. Author (GRA)

N71-19749# National Aerospace Lab., Tokyo (Japan).
ON THE AERODYNAMIC CHARACTERISTICS OF A FREE FLIGHT MODEL FFM-10
Toshio Kawasaki, Hideo Saito, and Iwao Kawamoto Jun. 1970 53 p refs In JAPANESE; ENGLISH summary
(NAL-TR-210 Avail: NTIS

A free flight model FFM-10 equipped with NAL-7 rocket motor in the fuselage was developed for measurement of dynamic stability derivatives at subsonic and supersonic speeds. The FFM-10 has a simple configuration including a delta wing and a conical cylinder fuselage. The aerodynamic characteristics obtained from static and dynamic wind tunnel tests are discussed including a test in which a pair of ailerons and slippers were attached to the wind tunnel model. Author

N71-19750# National Aerospace Lab., Tokyo (Japan).
APPLICATION OF DORODNITSYN'S TECHNIQUE TO COMPRESSIBLE TWO DIMENSIONAL AIRFOIL THEORIES AT TRANSONIC SPEEDS
Junzo Sato Oct. 1970 14 p refs
(NAL-TR-220T) Avail: NTIS

The approximate compressible theories of two-dimensional airfoil sections at transonic speeds were obtained by means of Dorodnitsyn's technique. Both direct and inverse methods were formulated. The singular parts of solutions were solved exactly, in terms of the incompressible flow solutions for Joukowskii airfoil sections, and the remaining regular parts were transformed into a system of ordinary differential equations by means of Dorodnitsyn's integral methods; and the equations were integrated using the Runge-Kutta numerical mpthod. An iterative cycle was set up to make the resulting profiles close in the inverse method when the pressure distributions were arbitrarily prescribed. Several examples both for direct and inverse methods were computed for symmetric airfoil sections at zero angles of attack, with the region over which the integration was made being divided into two arbitrary strips. Airfoil sections having local supersonic regions without shock waves were obtained by means of the present inverse method. Author

N71-19796*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.
BUFFET LOAD MEASURING TECHNIQUE Final Report
A. M. Ellison Feb. 1971 109 p refs
(Contract NAS2-5917)
(NASA-CR-114287; HREC-5917-1; LMSC-HREC-D162888) Avail: NTIS CSCL 20D

An analytical and experimental study is presented of a new technique for determining the unsteady forces during a wind tunnel test of an elastic model. The analysis showed that by placing a wind tunnel model in the feedback circuit of a servosystem which includes a force generator, a force transducer, and a model response transducer, the dynamic response of the specimen will be forced to follow the input signal. If this input command is a tape recording of the model response due to wind tunnel excitation, then the force required to reproduce the response can be used to estimate the original wind tunnel excitation forces. This force obtained from the force generator is accurately measurable with the force transducer. A control system was developed which caused the model response to closely duplicate the command signal. Good accuracy was obtained in recovering the original modal forces. The design of a servosystem based on a 50-pound thrust force generator is presented. Author

N71-19883*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF THE INTERACTION OF A NACELLE-MOUNTED SUPERSONIC PROPULSION SYSTEM WITH A WING BOUNDARY LAYER
Glenn A. Mitchell and David F. Johnson Washington Mar. 1971 42 p refs
NASA-TM-X-2184; E-5983) Avail: NTIS CSCL 20D

A Mach 2.5 inlet nacelle was mounted adjacent to a simulated wing boundary layer. The extent of inlet shock and boundary layer interactions was determined for steady state inlet operation and unstart transients. Transients were initiated with bypass closure and throat overcontraction for an inlet coldpipe combination, the inlet with a choke point at the compressor face station, and the inlet mated to a J85-GE-13 turbojet engine. Engine stalls were also used to initiate transients. The effects of boundary layer height and wing-to-cowl-lip spacing were determined. The most severe transients were those resulting from engine stalls which produced wing-boundary-layer separations extending 2.8 cowl-lip diameters forward of the lip. Author

N71-20055# von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
FUNDAMENTAL ASPECTS OF FLOW SEPARATION UNDER HIGH LIFT CONDITIONS
H. P. Horton *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 19 p refs (See N71-20051 09-02)
Avail: NTIS

A qualitative description is presented of separation problems covering: two dimensional laminar and turbulent separation concepts, separated flow on single two dimensional airfoils, boundary layer separation bubbles, separated flow on multi-airfoil systems (wake and boundary layer mixing), and three dimensional separated flow. The possibility of applying theoretical techniques to the prediction of the maximum lift and drag of an airfoil is briefly discussed. E.C.

N71-20056# National Lucht-En Ruimtevaartlaboratorium, Amsterdam (Netherlands).

SOME NOTES ON TWO DIMENSIONAL HIGH LIFT TEST IN WIND TUNNELS

B. van den Berg *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 18 p refs (See N71-20051 09-02)
Avail: NTIS

Problems associated with two dimensional high lift tests are discussed in terms of the test setup in the wind tunnel, the design of the models, and the methods to determine the forces on the model. Tunnel wall interference effects are also discussed. These include the effect of the constraint which the tunnel walls impose on the flow as well as the danger of boundary layer separations on the tunnel walls. The necessity of boundary layer control at the model tunnel wall junctions is demonstrated. Author

N71-20057# British Aircraft Corp., Warton (England). Wind Tunnel Dept.

MODEL TESTING REQUIREMENTS AND TECHNIQUES FOR HIGH LIFT SCHEMES: THREE DIMENSIONAL ASPECTS

C. Russell *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 22 p refs (See N71-20051 09-02)
Avail: NTIS

The subject of three-dimensional high lift model testing is dealt with from the point of view of the development of a specific full-size project. Various topics and problems are dealt with, in approximately the order in which they would normally arise, from initial concept to data presentation. Author

N71-20101# National Aerospace Lab., Tokyo (Japan).

A CALCULATION OF THE PROFILE DRAG OF AIRFOILS AT LOW MACH NUMBERS

Toshio Kawasaki and Yoji Ishida 1970 19 p refs In JAPANESE; ENGLISH summary
(NAL-TR-198) Avail: NTIS

A method for calculating the profile drag of airfoils at low Mach numbers is presented. In this method the calculated or experimental pressure distributions on airfoils must be given in advance. The method consists of 1) calculation of laminar boundary layer by Thwaites' method, 2) prediction of instability point by Schlichting-Urtich's correlation curve, 3) prediction of transition point by Granville's correlation curve, 4) calculation of turbulent boundary layer by Head's method, and 5) calculation of wake by means of the Squire-Young relation. The procedure that predicts the instability point first and then predicts transition point seems to be more reasonable from the physical point of view. In this method, an approximate treatment of laminar separation bubbles which occur near the leading edge of airfoils was also studied. It was shown that an approximation is reasonable, at least to the short bubbles. Profile drag has been calculated by this method for several airfoils at various lift coefficients and Reynolds numbers. Comparison of the results with available experimental data show good agreement. The error based on calculated drag values is 3.7%. Author

N71-20106# National Aerospace Lab., Tokyo (Japan).

LOW SPEED WIND TUNNEL-TESTS OF THE FA-200-XS AIRPLANE MODEL INFLUENCED WITH GROUND EFFECTS

Kenichi Hirosue, Takatugu Ono, Hiroshi Takahashi, and Naoaki Kuwano 1970 35 p refs In JAPANESE; ENGLISH summary
(NAL-TR-201) Avail: NTIS

Tests were conducted in a 6 m. low-speed wind tunnel for the investigation of the effects of ground proximity on the static longitudinal characteristics of the FA-200-XS airplane model. The ground was simulated by a moving-belt test rig. The tests described cover cases of flap deflection with boundary layer control at power on and power off conditions. The effectiveness of elevator at ground proximity was also investigated. Author

N71-20115# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

CALCULATION OF THE THREE-DIMENSIONAL POTENTIAL FLOW AROUND LIFTING NON-PLANAR WINGS AND WING-BODIES USING A SURFACE DISTRIBUTION OF QUADRILATERAL VORTEX-RINGS

B. Maskew Sep. 1970 80 p refs
(TT-7009) Avail: NTIS

A numerical method for calculating the steady three-dimensional potential flow around lifting nonplanar configurations is outlined and a number of preliminary results presented which demonstrate the potentially wide range of application. The method is based on a surface distribution of quadrilateral vortex-rings. Each quadrilateral element has a control point at which the boundary condition of zero flow (vortex-induced plus free stream) through the surface is specified. The vortex-ring strengths are solved after evaluating all the vortex-ring influence coefficients for each control point in turn and applying the boundary condition. The vortex strengths are then used to obtain surface velocities, pressures, loads and moments. The results which are presented include some for cases involving wing alone (thin and thick), wing plus flaps (plain flaps and slotted flaps), wing-fuselage and wing in wind-tunnel. Author

N71-20128*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ROLL-CONTROL EFFECTIVENESS OF SEVERAL SPOILER CONFIGURATIONS ON AN AIRPLANE MODEL WITH WING SWEEP OF 55 DEG AND 75 DEG AT SUPERSONIC MACH NUMBERS

Clyde Hayes Washington Mar. 1971 64 p refs
(NASA-TM-X-2165; L-7177) Avail: NTIS CSCL 01A

An investigation has been conducted to determine the roll-control effectiveness of several spoiler configurations on an airplane model employing variable-sweep wings. The spoilers were located on either the movable outer wing panel or the fixed inboard panel. Leading edge extensions, deflected to provide roll control, were also investigated. The outboard-spoiler tests were made at Mach numbers from 2.50 to 4.63 at a constant Reynolds number of 3 million per 0.3048 meter (per foot). The inboard spoilers and leading-edge extensions were tested at Mach numbers from 1.50 to 2.86 at a constant Reynolds number of 2 million per 0.3048 meter (per foot). The results of the investigation showed that although the effectiveness of all the upper surface spoilers was small, there were configurations that produced rolling moments probably sufficient to trim the configuration and allow some maneuvering at low angles of attack. Lower wing-surface spoilers, inboard upper surface spoilers, and leading-edge extensions were all ineffective in producing significant amounts of rolling moment over the range of Mach number and angle of attack. Reversal of the direction of rolling moment with changing Mach number occurred with inboard spoilers. Author

N71-20157# Aircraft Research Association, Ltd., Bedford (England).

POSSIBILITIES FOR SCALE EFFECT ON SWEPT WINGS AT HIGH SUBSONIC SPEEDS. RECENT EVIDENCE FROM PRESSURE PLOTTING TESTS

A. B. Haines Feb. 1971 36 p refs Presented at AGARD Fluid Dyn. Panel Specialists' Meeting, Goettingen, Germany, 26 – 28 Apr. 1971
(ARA-18) Avail: NTIS

The possibilities for scale effect on swept wings under supercritical flow conditions at high subsonic speeds are discussed on the basis of evidence from pressure plotting tests on a variety of wings. For the Super VC 10, comparison of pressure distributions measured in flight, and in model tests at R = 5.4 million shows some scale effect but it is not dramatic, largely because there is no incipient rear separation tendency in the tunnel tests. For other designs

however, the scale effect could be much greater: it is shown that the underfixing technique has limitations when applied to a sweptback wing. Examples are included where the flow patterns are very complex with many interacting features, in such cases, it is often difficult even to forecast whether the scale effect is favorable or unfavorable. Author

N71-20181*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SUPERSONIC AERODYNAMIC CHARACTERISTICS OF A ROCKET-VEHICLE MODEL WITH LOW-ASPECT-RATIO WING AND TAIL SURFACES

Ernald B. Graves Washington Mar. 1971 52 p refs
(NASA-TM-X-2159- L-7339) Avail: NTIS CSCL 20D

A wind tunnel investigation was conducted to determine the static aerodynamic characteristics of a rocket vehicle model with low aspect ratio cruciform wing and tail surfaces at Mach numbers from 1.50 to 4.64. The results indicate that the model with the wings in the aft position provided less variation in the center of pressure location with Mach number than the model with the wings in the forward position. For both wing positions, however, the model exhibited non-linear pitching moment characteristics in the lower Mach number and angle of attack ranges. Little or no induced roll or yaw was indicated over the ranges of angle of attack and Mach number. Author

N71-20182*# General Motors Corp., Indianapolis, Ind. Allison Div.

EXPERIMENTAL INVESTIGATION OF ADVANCED CONCEPTS TO INCREASE TURBINE BLADE LOADING. VOLUME 7: PERFORMANCE EVALUATION OF MODIFIED JET-FLAP ROTOR BLADE

H. G. Lueders Washington NASA Mar. 1971 31 p refs
(Contract NAS3-7902)
(NASA-CR-1759; EDR-4909-Vol-7) Avail: NTIS CSCL 20D

The performance of a single stage turbine with a modified jet flat rotor blade was investigated over a range of secondary airflows and expansion ratios while operating at design equivalent speed. The blade modification consisted of reducing the axial chord at all radii 0.276 inch by removing metal from the leading edge portion of the original blade. The nose of the blade was recontoured to blend into the suction and pressure surfaces. The leading edge portion of the original blade had very little turning and it was therefore anticipated that the additional loading to the modified blade would be small. The results of the investigation are compared to the performance of the original jet flap blade. Both rotors were tested with the same stator. Author

N71-20539# Illinois Univ., Urbana.

HEAT TRANSFER IN RESONANT CAVITIES SPANNED BY LOW SPEED, TURBULENT, SHEAR LAYERS

D. L. Fenton and R. A. White [1970] 13 p refs
(Grant NSF GK-2053)
Avail: Issuing Activity

The effect of cavity resonance on the dynamic and thermal characteristics of resonant cavities at low speeds was measured in a free-jet wind tunnel. A model of heat transfer in resonant cavities spanned by low speed, turbulent, shear layers was used to correlate both resonant and nonresonant results. The effect of resonance at low speeds where the pressure oscillations were weak in relation to high speed results did not produce major flow changes. It was concluded that the cavity thermal characteristics could be satisfactorily predicted by the nonresonant theory since the resonance effects were immeasurable. J.M.

N71-20540# Illinois Univ., Urbana.

SOME RESULTS ON THE HEAT TRANSFER WITHIN RESONANT CAVITIES AT SUBSONIC AND SUPERSONIC MACH NUMBERS

Robert A. White [1970] 31 p refs
(Grant NSF GK-2053)
Avail: Issuing Activity

The heat transfer within two cavities (L/D = 1.25 and 2.0) exhibiting self-induced pressure oscillations (commonly referred to as resonance) is discussed. The tests were conducted with free stream Mach numbers between 0.35 and 1.5 with corresponding unit Reynolds numbers of 3,300,000/ft to 4,100,000/ft. The approaching boundary layer and shear layer over the cavities were turbulent at all times. The pattern for the heat transfer coefficient distribution over the cavity walls was in good agreement with that found by other investigators. The effect of the self-induced pressure oscillations, however, was found to cause large changes in the level of the heat transfer, with low values occurring at the distinctive peaks of the pressure oscillations. The ratio of the integrated heat transfer within the cavity to the heat transfer from a flat plate with area equal to the area of the cavity opening was found to vary from 1.10 to 0.40, depending on Mach number and cavity resonance conditions. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N71-19379# Nielson Engineering and Research, Inc., Palo Alto, Calif.

A CALCULATIVE METHOD FOR PREDICTING STORE SEPARATION TRAJECTORIES AT SPEEDS UP TO THE CRITICAL SPEED

Jack N. Nielson, Frederick K. Goodwin, and Marnix F. E. Dillenius *In* AGARD Aerodyn. Interference Jan. 1971 14 p refs Sponsored by AFFDL (See N71-19353 09-01)
Avail: NTIS HC $6.00/MF $0.95

A theory has been developed for predicting the trajectories of external stores dropped from high-speed aircraft up to the critical speed. The method consists of three steps: (1) prediction of the non-uniform flow field in the vicinity of the store; (2) prediction of store forces and moments in the nonuniform flow field; and (3) calculation of the trajectory. A vortex lattice method used for the first step predicts well the flow field velocity components under the wing or fuselage. A simplified slender body method for calculating the normal force and moment on the external store is moderately successful by comparison with experiment. Calculated trajectories based on the simplified method are in fair agreement with experiment. Author

N71-19380# Aircraft Research Association, Ltd., Bedford (England).

EXAMPLES OF AIRFRAME STORE INTERFERENCE

J. B. Berry *In* AGARD Aerodyn. Interference Jan. 1971 12 p refs (See N71-19353 09-01)
Avail: NTIS HC $6.00/MF $0.95

Effects of airframe-store interference on the side force and the drag increment due to pylon mounted underwing stores are discussed. The main features of the sidewash and pressure distributions in the flow field beneath a swept wing are described. It is noted that, while the loads on a store would be expected to vary significantly with its position under the wing, some of the

interference forces may be regarded as buoyancy effects, implying opposing forces on the aircraft. Examples of measured side force on stores and pylons show that a qualitative correlation can be obtained with underwing sidewash data. Comparisons of the axial force on stores and pylons and the drag increment with estimates of the freestream drag of the store assembly, are presented and, at low speed and low to moderate C, these demonstrate the expected cancellation of some of the interference forces. Brief descriptions of methods being developed for the prediction of store and pylon side force and installed drag increment are included. Author

N71-19381# McDonnell Aircraft Corp., St. Louis, Mo.
EVALUATION OF THE PREDICTION OF AIRPLANE STORE INTERFERENCE BY LINEAR THEORY
Gordon G. Grose and Dean R. Bristow *In* AGARD Aerodyn. Interference Jan. 1971 12 p refs (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

A ring-body analysis computer program is used to calculate the interference flow field at a store location due to a wing-body combination, and the resulting loads applied to the store. Interference loads predicted by linear theory are compared with test data on typical fighter bomber configurations at subsonic and supersonic speeds. The subsonic case consists of stowed load wind tunnel data on a body representing the SUU-16A gun pod, mounted on the outboard wing pylon of the F-4C airplane. The supersonic case consists of loads on a sting supported store model in the vicinity of a swept wing-body combination representing a fighter bomber at Mach 1.6. The results of the comparison show the detailed survey of the interference flow field provided by the method, and indicate that it is a promising method of estimating store interference effects from the airplane geometry. Author

N71-19382# Breguet-Aviation, Paris (France).
ANALYSIS OF THE EFFECTS OF EXTERNAL STORES FASTENED UNDER AN ARROW WING ON THE LONGITUDINAL STABILITY OF THAT AIRCRAFT [ANALYSE DE L'INFLUENCE DE CHARGES EXTERNES FIXEES SOUS LA VOILURE D'UN APPAREIL A AILE EN FLECHE SUR LA STABILITE LONGITUDINALE DE CET AVION]
R. Taisseire *In* AGARD Aerodyn. Interference Jan. 1971 13 p In FRENCH; ENGLISH summary (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

Wind tunnel test results show that external stores fastened under a swept wing by pylons decrease longitudinal stability of the aircraft. Most of this stability loss comes from the increased deflection of the horizontal tail due to vortice field development at the pylon's trailing edge: this is caused by the force of the local sideslip at the lower part of the wing that produce a lateral lift force on the pylon. The deflection changes the stability of the aircraft as a function of the angle of attack. Author

N71-19383# Boeing Co., Wichita, Kans.
SEPARATION CRITERIA FOR DENSELY PACKED STORES IN BOMB BAYS
Richard B. Holloway, Donald L. Sutcliffe, and James D. Woodward *In* AGARD Aerodyn. Interference Jan. 1971 10 p (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

Separation characteristics of the weapons in the densely packed B-52 bombing system configuration 1224-7 proved to be dependent on the release sequence, release interval and release airspeed. Several different release sequences were investigated to solve bomb collision problems. A successful sequence was derived which provided satisfactory bomb release characteristics when a minimum clearance of one bomb diameter between adjacent bombs is provided as the bomb clears the guide rails. Flight tests indicated the optimal performance of a three-bay configuration with a minimum release interval of 80 to 50 milliseconds. Author

N71-19384# Royal Aircraft Establishment, Farnborough (England).
FLIGHT INVESTIGATION OF A TECHNIQUE FOR THE MEASUREMENT OF THE TOTAL AND INTERFERENCE DRAG OF EXTERNAL STORES
K. P. King *In* AGARD Aerodyn. Interference Jan. 1971 13 p refs (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

Results are given of the flight investigation of a technique for the measurement of the drag of external stores which can be jettisoned. The technique is to drop the stores and evaluate the store drag from the resultant change in aircraft acceleration along the flight path. In an exploratory series of tests, 1000 lb bombs were dropped from a Hunter aircraft and the variation of the drag due to the stores as they separated from the aircraft was determined. The results indicate that, with this particular aircraft/store combination, there is no significant variation of the total installed drag with C sub L over the range tested but the interference drag varies linearly with C sub L squared. Author

N71-19385# General Dynamics/Pomona, Calif.
A METHOD FOR PREDICTING INTERFERENCE FORCES AND MOMENTS ON AIRCRAFT STORES AT SUBSONIC SPEEDS
F. D. Fernandes *In* AGARD Aerodyn. Interference Jan. 1971 9 p refs (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

A method is developed for theoretically predicting the loading on aircraft stores at separation for subsonic flow. The method consists of predicting the flow field about the aircraft by using singularity distributions to represent the aircraft according to linear theory; the effect of the variable interference flow field is integrated over the store by using the free-air load distribution properties of the store locally. Buoyancy effects are included. The loading over each store fin is given special consideration with regard to its interaction with the aircraft pylon and with other store surfaces. A FORTRAN computer program performs the calculations. Effects of aircraft wing, fuselage, pylons, and inlets are included. Store moment calculations under an F-4C aircraft are compared with test data. Author

N71-19387# Naval Ordnance Lab., White Oak, Md.
AIRCRAFT/STORE INTERFERENCE
Chris A. Kalivretenos *In* AGARD Aerodyn. Interference Jan. 1971 16 p refs (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

A series of tests relating to the carriage and separation characteristics of a newly developed rocket launcher pod are reported. The objectives of the tests were to identify those flight conditions under which separation of the launcher might result in damage to the aircraft and to obtain data from which the separation behavior could be predicted. Included in this series of tests was a pod installation force test, a flow-field survey test and a pod jettison test. In each investigation, the loaded and empty rocket launcher pods were suspended from the centerline and outboard shoulder stations of the scaled triple ejector rack located on the inboard wing station of an A-4 aircraft model. The pod tends to pitch nose upward at high aircraft angles of attack and nose downward at low aircraft angles of attack. In full-scale tests the nose of the empty pod collides with the wing of the aircraft when launched from the shoulder station at airspeeds below 250 knots and the tail impacts the rack when launched from the centerline at airspeeds above 450 knots. Author

N71-19388# Naval Ship Research and Development Center, Washington, D.C.

PREDICTION OF STORE LAUNCH CHARACTERISTICS THROUGH STATISTICAL METHODS

Michael A. Sekellick *In* AGARD Aerodyn. Interference Jan. 1971 11 p refs (See N71-19353 09-01)

Avail: NTIS HC $6.00/MF $0.95

Two statistical methods are presented which have the capability of generating equations to predict the separation characteristics of airborne stores from aircraft. A mathematical relation was found between a configuration, the launch conditions, and the associated trajectory. The aircraft/store combination was described by parameters representing the important geometric and physical features which affect separation behavior. Each launch event was catalogued in terms of such parameters and the resulting separation behavior. This data was then statistically analyzed to predict the outcomes of untried launch situations. Author

N71-19457*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

NOISE REDUCTION

James J. Kramer, David Chestnutt, Eugene A. Krejsa, James G. Lucas, and Edward J. Rice *In its* Aircraft Propulsion 1971 p 189–210 (See N71-19451 09-28)

Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Both conventional takeoff and landing (CTOL) and vertical/short takeoff and landing (V/STOL) aircraft noise is discussed. The subsonic aircraft flight profile is considered first. Noise is a factor for subsonic aircraft when they are landing and taking off. These aircraft land on a 3 deg glide slope, so that their altitude above the community is fairly well defined as a function of distance from touchdown. The engine power setting varies as the pilot maneuvers down the glide slope, but generally the engines are at about 25 percent of takeoff thrust. During takeoff the altitude above the community depends on the operating weight of the aircraft and the power setting. It is possible for the pilot to reduce power after he has achieved some safe altitude. This power reduction results in less noise. Author

N71-19516# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONSTRUCTION AND OPERATION OF THE AN-24 AIRPLANE [SAMOLET AN-24 KONSTRUKTSIYA I EKSPULATATSIYA]

Zh. S. Chernenko et al 26 Oct. 1970 576 p refs Transl. into ENGLISH from the Russian

(AD-716499; FTD-HC-23-448-69) Avail: NTIS HC $6.00/MF $0.95 CSCL 1/3

The book presents the basic data on the AN-24 airplane, including descriptions of the airframe, flight controls, landing gear, power plant, hydraulic, fuel, fire protection, anti-icing, air conditioning systems, and ground equipment. Each chapter includes some recommendations on servicing the individual components, assemblies, and systems. A separate chapter covers airplane operations. Author (GRA)

N71-19549# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.

THE ACOUSTIC ENVIRONMENT OF A DEFLECTED-JET VTOL AIRCRAFT

D. L. Smith and S. L. McFarland, Jr. Sep. 1970 44 p refs

(AD-715939; AFFDL-TM-70-1-FYA) Avail: NTIS CSCL 20/1

A noise survey conducted on a deflected-jet VTOL aircraft is described. The test aircraft was mounted on a vertical thrust stand with the nozzles oriented in the hover-stop position while engine runs were made at different power settings. Forty-one (41) microphones were located in the field on the port side of the aircraft and six (6) microphones were located at positions near the aircraft skin. The height of the field microphones was varied (5 ft, 10 ft, and 15 ft). One-third octave band spectra obtained from all microphones and for all engine power settings were flat and did not exhibit the haystack shape which is characteristic of a free jet. Typical one-third octave band sound pressure level spectra and contours of overall sound pressure level are presented. Estimates of jet total acoustic power are developed from the measurements and related to engine operating parameters. Expressions are derived to predict the one-third octave band spectra at positions in the field and on the vehicle from similarly configured aircraft for various engine operating conditions. Author (GRA)

N71-19696# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

OPTIMAL CONTROL OF ELASTIC FLIGHT VEHICLES

A. A. Baloev 9 Oct. 1970 12 p refs Transl. into ENGLISH from Tr. Kazansk. Aviats. Inst. (Kazan), no. 103, 1968 p 54–60

(AD-716517; FTD-HT-23-454-70) Avail: NTIS CSCL 1/3

A study was made of the optimal control of the rotational and transversal motions of flight vehicles taking into account their torsional and flexural deformations. The equations for the torsional vibrations of the vehicle at high Mach numbers are analyzed. The optimal control of bending deformations is approached by introducing equations for the axial vibrations of the vehicle and determining their boundary conditions. A numerical example illustrating the proposed method is given. Author (GRA)

N71-19731# Michigan Univ., Ann Arbor. Dept. of Naval Architecture and Marine Engineering.

THE WAVE RESISTANCE OF AN AIR-CUSHION VEHICLE IN ACCELERATED MOTION

Lawrence J. Doctors and Som D. Sharma Dec. 1970 199 p refs

(Contract N00014-67-A-0181-0018)

(AD-716055; Rept-099) Avail: NTIS CSCL 13/10

The report is concerned with the theoretical wave resistance of an air-cushion vehicle (ACV) traveling over water of uniform finite or infinite depth, in steady or unsteady motion. Referring first to steady motion, it is shown that the unrealistic oscillations in the wave resistance curve at low Froude numbers found by previous workers can be eliminated by using a smoothed out pressure distribution rather than one with sharp edges studied exclusively in the past. The main result of unsteady motion calculations is that the peak wave resistance in shallow water, even in moderately accelerated motion, is appreciably less than the corresponding steady-state value. One feature of unsteady motion is that besides wave resistance there is another mechanism transferring energy to the free surface which is called the dynamic sustention power. Contrary to intuition, the wave resistance in unsteady motion over finite depth sometimes becomes negative at supercritical Froude numbers before finally approaching zero at infinite speed. Author (GRA)

N71-19769# RAND Corp., Santa Monica, Calif.

R AND D IN SOVIET AVIATION

Arthur J. Alexander Nov. 1970 49 p refs

(Contract F44620-67-C-0045; Proj. RAND)

(AD-716410; R-589-PR) NTIS CSCL 5/3

Research, design, development, and manufacture of Soviet aircraft are concentrated in the Ministry of Aviation Industry. However, the various functions are performed by administratively separate organizations. The present structure can be traced back to 1939, when a reorganization of the industry raised a number of young individuals to positions of authority following a period of intense purges. Information flows link the separate organizations. Research institutes provide design bureaus and manufacturing plants with handbooks of aerodynamic forms and structures and lists of approved materials and manufacturing techniques. Design starts

with a small, short-term effort called the pre-project, which takes only a few months to prepare. Simplicity, commonality, and design inheritance are important features of design practice. Author (GRA)

N71-19812# Federal Aviation Administration, Oklahoma City, Okla. Office of Aviation Medicine.
EVACUATION TESTS FROM AN SST MOCK-UP
J. D. Garner and John G. Blethrow Dec. 1970 28 p
(AA-AM-70-19) Avail: NTIS

A comparative study of passenger flow rates through Type 1 and Type A aircraft door exits was made with two 280-passenger groups from the full-scale Lockheed Supersonic Transport mock-up, mounted in a belly-landing attitude. The first load of 280 passengers and 9 crew members evacuated the mock-up through the right side containing four minimumum-size Type 1 and three minimum-size Type 3 exits in 70.7 seconds. A second load of 280 passengers evacuated the left side of the mock-up containing three minimum-size Type A exits in 47.4 seconds. Each passenger group reloaded and performed another evacuation for (1) the effect on flow rates of a 12-inch increase in height of a Type 1 exit, and (2) the effect of passenger flow rates through the forward and aft Type A exits from a single aisle configuration. Effects of step-down distances outside the fuselage and influences of one and two lines to double Type A doors during escape were evaluated. Cabin crew assist spaces at double doors were under study to establish guidelines for requirements involving crew interference within passageways to the doors. An analysis of passenger intelligibility of crew commands revealed a lack of comprehension of verbal instructions. These and other influencing factors are described in the report. Author

N71-19817# Boeing Co., Seattle, Wash. Military Aircraft Systems Div.
COCKPIT GEOMETRY EVALUATION, PHASE 2. VOLUME 1: PROGRAM DESCRIPTION AND SUMMARY Final Report, 1 Jan.–21 Dec. 1969
Patrick W. Ryan Feb. 1971 124 p refs
(Contract N00014-68-C-0289)
(AD-716395; D162-10125-2-Vol-1, JANAIR-700201-Vol-2) Avail: NTIS CSCL 1/3

The Cockpit Geometry Evaluation Program is an experimental development to establish a standardized method for evaluating the physical geometry of a crew station. It evaluates the physical compatibility of any sized seated crew member with any crew station beginning with the design concept. Data on the geometry of the crew station, the anthropometric characteristics of the crew members, and the sequence of tasks to be performed are stored in a computer. Mathematical routines provide dynamic movement for a variable-sized mathematical man-model. Numerical performance indicators, identification of physical and visual interferences, and reach infeasibilities are output. The program was originally planned as a six-phase development. Each sophisticating phase is designed to provide an immediately usable tool. The development is highly dependent on the laboratory acquisition of identified human data requirements. Volume I summarizes the results and techniques of Phase II, and gives a sample of input and output from the computer. Author (GRA)

N71-19901# National Aviation Facilities Experimental Center, Atlantic City, N.Y.
TITANIUM FUSELAGE ENVIRONMENTAL CONDITIONS IN POST-CRASH FIRES Final Report, 1968–1970
Constantine P. Sarkos Mar. 1970 74 p refs
(FAA-RD-71-3; FAA-NA-71-2) Avail: NTIS

A 28-foot titanium fuselage was exposed to a 400-square-foot JP-4 fire for about 2 1/2 minutes. The titanium fuselage remained intact, thus preventing any flames from entering into the cabin. Heating of the cabin pressure sealant and insulation caused these materials to burn. This, in turn, caused significant increases in temperature, smoke, and toxic and combustible gases within the cabin at about one minute after fuel ignition and a flash fire at two minutes. Theoretical heat transfer calculations were compared with thermocouple data from a section of the fuselage whose the insulation did not burn. This comparison indicated that if the insulation and sealant were inert, habitable conditions would have been maintained within the cabin for at least five minutes, and perhaps more. Author

N71-19912*# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A SECOND ORDER SLENDER WING THEORY FOR WINGS WITH LEADING EDGE SEPARATION
Joseph P. Nenni and Chee Tung Apr. 1969 45 p refs
(Contract NAS1-7650)
(NASA-CR-66762; CAL-BB-2530-5-1) Avail: NTIS CSCL 20D

A second-order, slender-wing theory was developed for incompressible flow over low-aspect-ratio wings with and without leading-edge separation. The theory is second order in terms of the ratio of span to chord which is proportional to aspect ratio. The theory has been developed using the technique of matched asymptotic expansions. The Brown and Michael flow model was used for the case with leading-edge separation. The theory proves to be somewhat limited in that it can only be reasonably applied to wings which satisfy the Kutta condition at the trailing edge in the first approximation. The present results obtained for an aspect-ratio-one gothic wing represent a significant improvement for the separated flow case over the first-order result but the predicted lift is still somewhat higher than the experimental data. Author

N71-20051# Advisory Group for Aerospace Research and Development, Paris (France).
ASSESSMENT OF LIFT AUGMENTATION DEVICES
Feb. 1971 284 p refs Presented at the Lecture Series, Rhode-Saint-Genese, Belgium, 20–24 Apr. 1970; Sponsored by AGARD and von Karman Inst.
(AGARD-LS-43-71) Avail: NTIS

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15. THE HUNTING H.126 JET FLAP RESEARCH AIRCRAFT K. D. Harris (Hawker Siddeley Aviation, Ltd., Hatfield, England) 7 p refs (See N71-20066 09-02)

16. AERODYNAMIC RESEARCH ON HIGH LIFT SYSTEMS F. Mavriplis (Canadair, Ltd.) 13 p refs (See N71-20067 09-02)

N71-20052# Hawker Siddeley Aviation, Ltd., Hatfield (England). Aerodynamic Dept.

AERODYNAMICS OF MECHANICAL HIGH LIFT DEVICES

D. M. McRae *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 23 p refs (See N71-20051 09-02)

Avail: NTIS

The purpose is to describe in general terms the stalling of conventional airfoils and the effects of mechanical high lift devices thereon. The factors affecting maximum lift coefficient are discussed in the context of estimation methods. Drag is also discussed. Author

N71-20053# Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany). Inst. fur Stromungsmechanik.

AERODYNAMICS OF PNEUMATIC HIGH LIFT DEVICES

J. von der Decken *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 36 p refs (See N71-20051 09-02)

Avail: NTIS

An introductory survey of pneumatic boundary layer and circulation control schemes for increasing maximum lift is given. The physical background of boundary layer control by suction and blowing, and of supercirculation and slipstream effects, is described; also the aerodynamic efficiency of the different devices is estimated by theoretical approaches. Finally, practical applications and performance evaluation of pneumatic devices are discussed. Author

N71-20054# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Dept. des Etudes de Synthese.

AERODYNAMICS OF VARIABLE SWEEP

Ph. Poisson-Quinton *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 19 p refs (See N71-20051 09-02)

Avail: NTIS

Aerodynamic problems in the design of variable sweep aircraft are discussed. Selection of pivot location is reviewed, as well as investigations of high lift devices, wing camber, and longitudinal instability near the stall on variable sweep configurations. Application of this configuration to reusable spacecraft is mentioned. E.C.

N71-20058# Boeing Co., Seattle, Wash.

ANALYSIS OF TRANSPORT APPLICATIONS FOR HIGH LIFT SCHEMES

L. B. Gratzer *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 23 p refs (See N71-20051 09-02)

Avail: NTIS

The way in which the design tradeoff process affects airplane economics is illustrated in relation to the impact of high lift system design on the final configuration selection. An assessment of representative high lift concepts, including boundary layer control, is given in terms of low-speed performance potential. For long-range transport airplanes operating from long runways, it is shown that well-designed mechanical flap systems are generally competitive with more sophisticated concepts involving blowing or suction boundary layer control (BLC). However, recent progress in high lift technology indicates that significant performance gains for long-range airplanes may be possible using BLC techniques. The gains for airplanes designed to operate from shorter fields appear attractive and achievable with today's technology. For STOL airplanes the use of BLC to provide high wing lift together with direct lift from the engines, or a more highly integrated form of lift augmentation such as the jet flap, is mandatory. The interaction between high lift system design and problems involving the stability and control characteristics of the airplane are considered. Author

N71-20059# Breguet-Aviation, Velizy (France). Div. Aerodynamique.

ANALYSIS OF COMBAT AIRCRAFT APPLICATIONS FOR LIFT AUGMENTATION DEVICES

R. Taissaire *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 21 p (See N71-20051 09-02)

Avail: NTIS

Problems associated with the design of high lift systems for combat aircraft are reviewed. Performance and flying qualities are considered. Low level high speed flying requires small wing thickness to chord ratio (about 5 to 7%), high sweep angle (35 to 45 degs), small aspect-ratio (3 to 4) and high wing loadings (about 400 to 500 kg per sq. meter). With such a wing, it is difficult to provide good take-off and landing performance for short field operation while maintaining good flying qualities at low speeds. Effective high lift devices are needed to achieve the low stalling speeds required for short takeoff and landing distances and their design must provide a satisfactory level of control in the low speed flight range. The review is intended to clarify the problems encountered in achieving these aims and to indicate ways of solving them. Author

N71-20060# Aeroplane and Armament Experimental Establishment, Boscombe Down (England). Performance Div.

FLIGHT TESTING MILITARY TRANSPORT AIRCRAFT FOR CLEARANCE IN THE STOL ROLE

K. P. Eyre *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 24 p ref (See N71-20051 09-02)

Avail: NTIS

The types of tests which are likely to be required to clear an aircraft from handling and performance aspects for military STOL applications are discussed. Tests made to clear the Andover C. Mk. 1 are given as an example. No special consideration is given to particular high lift devices each of which may of course introduce individual problems. However, it is considered that in the case of STOL aircraft generally the problem of variability in behavior may require more than usual attention due to the rapid maneuvers and short distances involved with considerable dependence on pilot technique. Author

N71-20061# Rolls-Royce, Ltd., Bristol (England). Bristol Engine Div.

LIFT AUGMENTATION DEVICES AND THEIR EFFECT ON THE ENGINE. PART 1: INTERFACE PROBLEMS BETWEEN ENGINE AND AIRFRAME

J. A. Hooper *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 18 p (See N71-20051 09-02)
Avail: NTIS

Interface problems between engine and airframe associated with the achievement of short field performance are described. Civil and military aircraft are treated with the main emphasis on civil STOL. A range of possible lift augmentation devices is considered, and their effect on engine design is shown. The associated problems of noise and performance are also considered. Optimum engine designs and their particular characteristics for various systems are described. Author

N71-20062# Rolls-Royce, Ltd., Bristol (England). Bristol Engine Div.
LIFT AUGMENTATION DEVICES AND THEIR EFFECT ON THE ENGINE. PART 2: THERMODYNAMIC PROBLEMS AND SOME POSSIBLE SOLUTIONS
E. A. White and H. C. Hillier *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 13 p (See N71-20051 09-02)
Avail: NTIS

The effects of the previously established design criteria on the thermodynamics of the engines for STOL applications are discussed. Several possible engine solutions with their associated advantages and disadvantages are described. Author

N71-20064# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
A NEW TECHNIQUE FOR AEROFOIL LEADING EDGE STUDIES
J. Monnerie *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 5 p ref (See N71-20051 09-02)
Avail: NTIS

Illustrations are given from an investigation of flow separation bubbles which develop near an airfoil leading edge. These include a drawing of the airfoil profile, a velocity diagram for a profile with a Handley Page slat, a plot of the similarity between the flow on two models, surface flow visualization near the leading edge, boundary layer curves in the bubble region, and water tunnel model visualization data. E.C.

N71-20065# Royal Aircraft Establishment, Farnborough (England).
SOME COMMENTS ON CHARACTERISTICS OF HIGH LIFT WINGS
D. N. Foster *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 5 p refs (See N71-20051 09-02)
Avail: NTIS

Wind tunnel tests, under as near to two dimensional conditions as possible, were carried out on a wing section with plain leading and trailing edge flaps having boundary layer control by blowing at the flap knees. A range of flap deflections were tested; results are presented for the condition with no leading edge flap deflection and with the trailing edge flap deflection 20 deg. Results suggest that the inviscid lift is achievable with a momentum coefficient which is dependent on the angle of incidence (or the lift); that under these conditions a pressure distribution will be measured which is very similar to the inviscid predictions; and that sensibly zero drag will result. Drag with high lift devices is also discussed. Author

N71-20066# Hawker Siddeley Aviation, Ltd., Hatfield (England).
THE HUNTING H-126 JET FLAP RESEARCH AIRCRAFT
K. D. Harris *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 7 p refs (See N71-20051 09-02)
Avail: NTIS

The jet flap principle is reviewed, as well as the development of a piloted research aircraft to test the principle. Aircraft thrust losses, stability and control problems, and stalling characteristics are discussed. E.C.

N71-20067# Canadair, Ltd., Montreal (Quebec).
AERODYNAMIC RESEARCH ON HIGH LIFT SYSTEMS
Fotis Mavriplis *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 13 p refs (See N71-20051 09-02)
Avail: NTIS

Aspects of two dimensional flow research on high lift systems are discussed. A theoretical method is described for calculating two dimensional potential flow about multi-element high lift airfoils. The method is based on the distribution of vorticity on the airfoil contour. A wall blowing technique is also described which was developed for testing effectively complex high lift models in the wind tunnel. It was used to study the effect of leading edge and trailing edge devices on the aerodynamic characteristics of a 17% and a 10% thick airfoil. Finally, comparisons of calculated and experimental data obtained on some of the complex configurations tested are presented to demonstrate the usefulness of the methods described. Author

N71-20068# Douglas Aircraft Co., Inc., Long Beach, Calif.
DEVELOPMENT OF A BASIC METHODOLOGY FOR PREDICTING AIRCRAFT STOPPING DISTANCE ON A WET RUNWAY Final Report, 1966–1970
O. W. Preston, G. W. Kibbee, R. H. Muroyama, and R. A. Storley Mar. 1971 19 p refs
(Contract DOT-FA-66-NF-128)
(FAA-NA-70-5; FAA-RD-70-62) Avail: NTIS

Studies and tests were conducted to develop a basic methodology for predicting the test aircraft stopping distance on a wet runway. Development consisted of a series of wet and dry runway tests utilizing the FAA Variable Slip Runway Friction Tester and an instrumented nonflyable test aircraft followed by an analysis of the test results using an analog computer simulation of the aircraft. A relationship was established between wet runway friction measured by the friction tester and friction available to the braking wheels of the test aircraft. The methodology consists of using this relationship and an analog computer aircraft simulation, incorporating actual antiskid and braking system hardware, to prepare a nomograph showing aircraft stopping distance as a function of the runway friction measured by the FAA Variable Slip Runway Friction Tester. Correlation exists between friction measured by the friction tester and friction available to the tires of the test aircraft when normalized with respect to theoretical hydroplaning velocities. Author

N71-20069# National Aviation Facilities Experimental Center, Atlantic City, N.J.
INVESTIGATION OF THE EFFECTS OF RUNWAY GROOVES ON WHEEL SPIN-UP AND TIRE DEGRADATION Final Report, Nov. 1969–Mar. 1970
Charles R. Grisel Apr. 1971 26 p
(FAA-RD-71-2; FAA-NA-70-47) Avail: NTIS

Tests were conducted at three airports having different runway groove configurations. The objective of these tests was to determine if grooves change the rate of wheel spin-up and if they produce cuts in the tires of the test aircraft. Although no evidence of tire cutting was observed, it was found that the wheel spin-up rate for the test aircraft was increased by the runway grooves. The extent of the increase was influenced by the width of the grooves. Author

N71-20102# National Aerospace Lab., Tokyo (Japan).
ANALYTICAL AND SIMULATION STUDIES ON THE HEIGHT CONTROL SYSTEM OF FLYING TEST BED. 2: ON SOME PROBLEMS
Yuso Horikawa and Tadao Kai 1970 46 p refs In JAPANESE, ENGLISH summary
(NAL-TR-200) Avail: NTIS

For the purpose of studying the fundamental problems of VTOL operations for lift jet type VTOL aircrafts, a flying test bed (FTB) has been developed. The analytical and simulation studies have been done with a flight simulator consisting of an analog computer and a simple fixed base cockpit, and criteria of these studies were not based on the pilot rating system but the quantitative analysis of simulation results. Operational probelems which were analyzed and these results are as follows. (1) safety problems when one engine out in flight, (2) effect of transient response when redundant triple systems change over from the normal system to the standby system, (3) effect of attitude motion on height control, (4) effects of nonlinearities, and (5) effect of vertical gust in flight. Author

N71-20156*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

INVESTIGATION OF FLOW FIELD DEVELOPMENT FOR A SERIES OF SONIC BOOM WIND TUNNEL MODELS

Harry L. Runyan, Herbert R. Henderson, Odell A. Morris, and Christine G. Pusey Washington Mar. 1971 21 p refs
(NASA-TN-D-6143; L-7236) Avail: NTIS CSCL 20D

A wind tunnel experiment has been conducted at a Mach number of 2.7 to study the growth of the pressure field as a function of distance from sonic boom models. Six models were tested: two delta planforms and four rectangular planforms including one model with side plates. The measured sonic boom pressure signatures are compared with calculated signatures based on theories for two- and three-dimensional flows. Author

N71-20158*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EXPERIMENTAL INVESTIGATION OF THE DIRECTIONAL CONTROL CAPABILITY OF 18 × 5.5, TYPE 7, AIRCRAFT TIRES ON WET SURFACES

Thomas A Byrdsong Washington Mar. 1971 19 p refs
(NASA-TN-D-6202; L-7547) Avail: NTIS CSCL 01A

An experimental investigation was made to evaluate the free-rolling cornering capability of a high-speed aircraft nose-wheel tire. Data were obtained for several 18 × 5.5, type 7 tires with three tread designs (three-grooved, six-grooved, and dimple) at wheel yaw angles up to 30 deg and ground speeds up to 110 knots on various wet and flooded test surfaces. The results show a characteristic variation of cornering capability with wheel yaw angle and suggest a maximum cornering capability at an angle of approximately 10 deg. The surface texture, wetness condition, and ground speed are shown to have a pronounced effect on the cornering capability of the test tires. The results also show that the tires with three- and six-grooved-tread designs developed cornering capability that was comparable to and significantly greater than that of the dimple-tread tires. Author

N71-20183*# Southampton Univ. (England). Inst. of Sound and Vibration Research.

THE TRANSMISSION OF SONIC BOOM SIGNALS INTO ROOMS THROUGH OPEN WINDOWS. PART 1: THE STEADY STATE SOLUTION

P. G. Vaidya [1970] 35 p refs
(Grant NGR-52-025-003)
(NASA-CR-111786) Avail: NTIS CSCL 20A

As a first step in calculating transient pressure time-histories in rooms due to sonic booms, a solution is sought for the pressure field generated inside a room due to an incoming harmonic wave, incident onto a window. The basic problems of sound radiation and diffraction are first discussed. These are used to obtain a solution in the case of a room with hard walls and normal incidence, first by viewing the room as a terminated duct, and later by the Green's function method. The concept of the mode excitation distribution function is used to match the boundary conditions. This concept has been extended for oblique incidence. General properties of the distribution function were derived. Author

N71-20271*# Bell Aerospace Co., Buffalo, N.Y.

AN ANALYSIS OF CORRELATING PARAMETERS RELATING TO HOT GAS INGESTION CHARACTERISTICS OF JET VTOL AIRCRAFT

V. Krishnamoorthy Mar. 1971 46 p refs
(Contract NAS1-10448)
(NASA-CR-111867) Avail: NTIS CSCL 01A

Inlet-air temperature rise data obtained from previous tests on two small-scale configurations of a jet VTOL fighter-type model over a range of exhaust pressure ratios, exhaust gas temperatures and surface wind velocities, was analyzed for correlation with several correlating parameters. The correlating parameters are used to predict the large-scale model inlet temperature rise. The large and small-scale results are compared. Author

N71-20292*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

UTILIZATION OF A FIXED BASE SIMULATOR TO STUDY THE STALL AND SPIN CHARACTERISTICS OF FIGHTER AIRPLANES

Frederick L. Moore, Ernie L. Anglin, Mary S. Adams, Perry L. Deal, and Lee H. Person, Jr. Washington Mar. 1971 35 p refs
(NASA-TN-D-6117; L-7420) Avail: NTIS CSCL 01A

An investigation was conducted to determine the feasibility of using a fixed-base simulator for studies of the stall and spin characteristics of fighter airplanes. The simulator equipment consisted of a fixed-base cockpit with limited physical cues, including a visual display containing a target airplane for a realistic tracking task. The project was conducted as a real-time digital simulation with six-degree-of-freedom nonlinear equations of motion in which aerodynamic input data for two representative fighter configurations were used. One configuration was included to document its stall characteristics, whereas the spin and recovery characteristics of the other configuration were studied. The results of the study indicated that the fixed-base simulation technique could be employed for studying the stall and spin characteristics of an airplane. Author

N71-20305*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

FIXED-BASE SIMULATION EVALUATION OF VARIOUS LOW-VISIBILITY LANDING SYSTEMS FOR HELICOPTERS

Paul S. Rempfer, Lloyd E. Stevenson, and Joseph S. Koziol, Jr. Washington Apr. 1971 119 p refs
(NASA-TN-D-5913; C-119) Avail: NTIS CSCL 01A

A fixed-base simulation evaluation x various low-visibility landing systems for helicopters has been made. The low-visibility mission consisted of a straight-in glide slope and localizer approach with a flare and deceleration maneuver at the end. The landing systems consisted of a fully automatic system and six manual systems. The manual systems consisted of three flight control modes each being flown with a flight director indicator and then with raw data displays. The three flight control modes were an attitude command mode with an unaugmented vertical axis, an attitude command mode with rate of descent command mode. The landing systems and the helicopter were simulated on a hybrid computer. The landing systems were all digital. A series of six subjects consisting of two engineers and four instrument-rated pilots flew each of the modes for the landing mission. Performance data were recorded by the digital computer and analog recorders. The relatice performances of the modes are presented. Author

N71-20334# Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).

AUTOMATIC FLIGHT CONTROL SYSTEMS [SISTEMAS

AUTOMATICOS DE CONTROL DE VUELO]
T. Hajduk 1969 33 p In SPANISH *Its* Informe de Contrato No. 9
Avail: NTIS

The dynamic response of a vehicle and its automatic flight control system is analyzed for four distinct types of systems. The system types are: (1) use of an activating signal to realign the control surfaces; (2) use of an error in postion for the basic correction signal; (3) use of a signal derived from the angular velocity of the vehicle; and (4) use of angular velocity of the displacement of the control surfaces for the correction signal.
Transl. by F.O.S.

N71-20369# Dunlap and Associates, Inc., Santa Monica, Calif.
THE INFLUENCE OF ENVIRONMENTAL FACTORS IN AIRCRAFT CARRIER LANDINGS AND ACCIDENTS
Clyde A. Brictson *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 7 p refs (See N71-20351 09-04)
Avail: NTIS

An analysis of carrier landing accidents during a five year period (1965–1969) showed that environmental causal factors contributed to 27% of all jet landing accidents. Pitching deck was the most frequently cited environmental causal factor and was cited in 15% of the landing accidents. The F4 aircraft had the highest percentage of environment related mishaps (36%), half of which were pitching deck accidents (18%). Furthermore, pitching deck conditions were found to be related to two accident types, hard landings and undershoots, which accounted for 93% of all landing accidents. Pilot/aircraft height tracking responses under different levels of deck pitch were analyzed and results indicate that deck motion in excess of four feet may result in a 180 deg phase relation between deck pitch and pilot height tracking for certain aircraft. Synchronized records of deck motion and pilot aircraft height tracking during final approach to night carrier landing deck chasing phenomenon and provide graphic evidence of the consequences of 180 deg phase lags, especially for high accident risk aircraft.
Author

N71-20421*# Lockheed-California Co., Burbank.
RESEARCH PROGRAM TO DETERMINE ROTOR RESPONSE CHARACTERISTICS AT HIGH ADVANCE RATIOS Final Report
W. A. Kuczynski and G. J. Sissingh Feb. 1971 220 p refs Sponsored in part by Army
(Contract NAS2-5419)
(NASA-CR-114290; LR-24122) Avail: NTIS CSCL 01A

The stability and response characteristics of directly controlled rigid rotors at high advance ratios were determined experimentally. The applicability of an existing mathematical model was evaluated by correlation with the test results. Provisions were made in the design of the rotor to vary the blade Lock number and the first flapping mode frequency. The blade Lock number was changed by adding weight at the tip of each blade. The flapping frequency was varied in two ways; by changing the stiffness of an inboard section of the blade (flapping flexure) and by changing the rotor speed. For each blade, one tip weight and two flexures were available which yielded four basic rotor configurations. Each basic configuration was tested at various rotational speeds. Eighteen discreet combinations of blade Lock number and flapping frequency were investigated. Nominal blade Lock number values were 5.0 and 3.0 and flapping frequency ranged from 1.14 to 2.39. Response data were taken at advance ratios up to 1.75 (including hover). Rotor derivatives with respect to four excitations were obtained, including collective pitch, longitudinal cyclic pitch, lateral cyclic pitch, and rotor shaft angle of attack.
Author

N71-20670* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ATTITUDE CONTROLS FOR VTOL AIRCRAFT Patent
Frank A. Pauli, inventor (to NASA) Issued 14 Oct. 1969 (Filed 24 Jan. 1968) 7 p Cl. 244-76; Int. Cl. B64c13/50, 15/14
(NASA-Case-XAC-08972; US-Patent-3,472,470;
US-Patent-Appl-SN-700174) Avail: US Patent Office CSCL 01A

Attitude control for VTOL aircraft can be achieved by employing reaction nozzles displaced from various axes of the aircraft. The nozzles are arranged two sets with each set of nozzles being fed by a separate duct system selectively connected to a source of gas under pressure, preferably bled off from a jet engine. For control about each orthogonal axis, nozzles of the first set are controlled mechanically and nozzles of the second set are controlled electrically by servo motors. A valve is interposed between the supply duct and ducts feeding the separate systems and is movable into two positions to supply one or the other system exclusively of the other. Biasing means urges the valve into position for manual control and electrically operated means urges it into position for electrical control. Hence, the system is returned to manual control immediately at pilot option or by failure of the electrical system.
Official Gazette of the U.S. Patent Office

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N71-19389# Oak Ridge National Lab., Tenn.
ANALYSIS OF CREEP DATA IN THE SELECTIONS OF MATERIALS FOR THERMIONIC CAPSULES
R. L. Stephenson Nov. 1970 11 p Presented at IEEE Thermionic Conversion Specialist Conf., Carmel, Calif., 21–23 Oct. 1969
(Contract W-7405-eng-26)
(ORNL-TM-3202; CONF-691024-4) Avail: NTIS

The creep-rupture properties of arc-melted tungsten, W–5% Re, W–26% Re, W–25% Re–30% Mo, and chemically vapor deposited (CVD) tungsten were studied with a view toward the selection of optimum materials for isotope containment for thermionic capsules. The times to 1, 2, and 5% creep are presented along with the time to rupture as a function of stress. The interaction of various failure criteria is discussed with reference to the selection of allowable stresses.
Author (NSA)

N71-19438* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
METHOD AND APPARATUS FOR BATTERY CHARGE CONTROL Patent
Thomas J. Hennigan, Nelson H. Potter, and Kenneth O. Sizemore, inventors (to NASA) Issued 4 Feb. 1969 (Filed 13 May 1966) 6 p Cl. 320-23; Int. Cl. H02j7/04; Int. Cl. H01m45/04
(NASA-Case-XGS-05432; US-Patent-3,426,263;
US-Patent-Appl-SN-549860) Avail: US Patent Office CSCL 10C

A battery charging system is described which is capable of maintaining cell-to-cell voltage balance by first limiting the charging voltage to a first predetermined level and thereafter, through the performance of a control circuit cooperating with the battery, limiting the charging voltage to a second predetermined lower level. The magnitude of the second predetermined level voltage is chosen to be sufficient to keep the battery charged yet insufficient to keep the battery charged and to cause any damage to the battery.
Official Gazette of the U.S. Patent Office

N71-19545* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLAR CELL MATRIX Patent

Robert K. Yasui, inventor (to NASA) Issued 9 Sep. 1969 (Filed 26 Sep. 1967) 6 p Cl. 136-89; Int. Cl. H01m5/00 Sponsored by NASA
(NASA-Case-NPO-10821; US-Patent-3,466,198; US-Patent-Appl-SN-670814) Avail: US Patent Office CSCL 10A

A conductor configuration is described for connecting cells in parallel to form a submodule, which are in turn connected in series to form a cell matrix. The conductor has segments interconnected in series with the entire combinations flexible to provide the desired matrix flexibility. Each conductor segment has a plurality of perforated pads used to form an electrical contact with one electrode or terminal of a cell in one submodule. The segment also includes at least one contact strip used to form contact with an electrode of a cell in an adjacent submodule and thereby produce the series interconnection between submodules.
Official Gazette of U.S. Patent Office

N71-19649*# Hughes Aircraft Co., Culver City, Calif.
PRIME POWER SYSTEMS, PART 6
In its Parametric Analysis of Microwave and Laser Systems for Commun. and Tracking, Vol. 3 Feb. 1971 p 475-523 refs (See N71-19643 09-07)
Avail: NTIS CSCL 10A

Three types of prime power systems for spacecraft power supplies are discussed. The systems are: (1) solar power systems which include solar thermoelectric systems, solar thermionic systems, and solar dynamic systems, (2) nuclear power systems using radio isotope sources or reactor dynamic systems, and (3) chemical power systems in the form of electric batteries and fuel cells. The effect of mission duration, power requirements, environment, and goals on the selection of power sources is presented.
Author

N71-19652*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROBABILITY CONCEPTS APPLIED TO SEQUENTIAL EQUIPMENT OPERATION
Lamar Layton Washington Mar. 1971 7 p refs
(NASA-TN-D-6206; G-1017) Avail: NTIS CSCL 12A

Probability concepts are applied to an operation in which a given number of items of equipment are sequentially activated. Only one item is operating at any time. When it fails, another item is activated. The probability that the system will fail prior to a specified time is discussed, and some examples are presented.
Author

N71-19719# Arinc Research Corp., Annapolis, Md.
RELIABILITY PREDICTION PROGRAM FOR ORGANIC RANKINE CYCLE ENGINE GENERATOR SYSTEMS
D. J. Hoffman Nov. 1970 47 p
(Contract DAAK01-70-D-4142-0002)
(AD-715965; B02-01-1-1081) Avail: NTIS CSCL 10/2

A reliability-prediction program was conducted to provide quantitative reliability predictions of two manufacturers organic Rankine-cycle engine generator systems and a computer program for calculating the predictions. Historical failure data were compiled; and a reliability-prediction mathematical model was developed. A computer program was developed, and reliability predictions were made for the two systems for a variety of missions and environments.
Author (GRA)

N71-19802# Systems Research Labs., Inc., Dayton, Ohio.
INVESTIGATION OF ELECTRICAL LOADS FOR ELECTROFLUID DYNAMIC GENERATOR
Krishan K. Joshi, T. H. Maloney, R. W. Griffith, and J. A. Decaire (ARL) Wright-Patterson AFB, Ohio ARL Oct. 1970 47 p ref
(Contract F33615-70-C-1515)
(AD-716102; ARL-70-0238) Avail: NTIS CSCL 10/2

In testing of generators in controlled environments, the provision of a simple, variable and effective electrical load is very important, as it must operate at conditions compatible with the generator output. One typical requirement is that of the high voltage Electrofluid Dynamic (EFD) generator at the Aerospace Research Laboratories. For this reason, investigation of various loading methods was carried out and the load employing the corona discharge mechanism appeared to be particularly compatible with the EFD generator.
Author (GRA)

N71-20185*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SHUTDOWN CHARACTERISTICS OF A SNAP-8 POWER CONVERSION SYSTEM
Thomas P. Hecker, Fred Boecker, and Robert J. Frye Washington Mar. 1971 22 p refs
(NASA-TN-D-6172; E-5993) Avail: NTIS CSCL 18N

An experimental study of the shutdown of a SNAP-8 mercury Rankine power conversion system was conducted to determine the system response to both normal and emergency shutdown procedures. A failure of the condenser coolant flow was the simulated system condition for the emergency shutdown procedure. The results of both shutdown procedures show that the system can be repeatably shut down in such a way as to ensure its restart capability. Transient data for three typical shutdowns are presented.
Author

N71-20186*# Westinghouse Electric Corp., Lima, Ohio.
HIGH TEMPERATURE CAPACITOR DEVELOPMENT
R. E. Stapleton Washington NASA Mar. 1971 73 p refs
(Contract NAS3-10941)
(NASA-CR-1799; WAED-69-29E) Avail: NTIS CSCL 09A

The progress made on improving the high-temperature stability and overall electrical properties of pyrolytic boron nitride capacitors is described. One method investigated was surface texturizing of pyrolytic boron nitride wafer surfaces by radio frequency off-sputtering. Removal of 3000 angstroms of surface material before application of electrodes resulted in a two- to three-fold reduction in electrical losses. Surface texture (ratio of true to apparent or geometric area) was measured by a double layer capacitance technique. These data were correlated with electrode adherence and capacitor losses and stability under thermal cycling and aging conditions at 1300 and 1100 F in vacuum. A second method that was studied was the deposition of a sputtered boron nitride barrier layer to a portion of the outer surfaces of the electrodes. Compression and aging tests conducted on multi-layered capacitors at 1100 F in vacuum showed that the barrier layer prevented platinum electrodes, on alternate capacitor wafers in a stack, from diffusing (bonding) together. This resulted in greater capacitance stability and lower electrical losses.
Author

N71-20264*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SPACE RADIATION ENVIRONMENT SIMULATOR FOR THE EVALUATION OF SOLAR CELLS
P. A. Newman, J. J. Hirshfield, H. E. Wannemacher, and M. Eck *In* NBS Space Simulation Oct. 1970 p 935-947 (See N71-20201 09-11)
(NASA-TM-X-66948) Avail: NTIS; SOD $6.25 CSCL 10C

A facility for studying the properties of solar cells and other optically sensitive devices under a wide range of environmental conditions such as could be found on extraterrestrial space missions has been developed. The system includes control of temperature, vacuum and solar irradiation while irradiating a 23 cm by 23 cm array of samples with 4 MeV protons or electrons. The samples can be controlled in temperatures between −170 C and 150 C, while a shroud, used to control radiative coupling, can be independently controlled between −196 C and 150 C. The vacuum system

evacuates the chamber to less than 1 × 10 to the minus 8th power torr in less than 4 hours. A compact zenon arc solar simulator provides a close match to the solar spectrum from low irradiances to an irradiance of four solar constants. An automatic data acquisition system is used to collect data in a form suitable for computer processing. Author

N71-20269*# General Electric Co., Philadelphia, Pa. Space Systems Organization.
DESIGN AND DEVELOPMENT OF A THIRTY WATT PER POUND 250 SQUARE FOOT ROLL UP SOLAR ARRAY. VOLUME 1: PROGRAM SUMMARY Final Report
N. Shepard, P. Perez, and K. Hanson 1 Feb. 1971 129 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952314)
(NASA-CR-117319; DOC-705D4286-Vol-1) Avail: NTIS CSCL 10C

The results of a program to develop the technology of the rollup solar array concept are summarized. A detailed design of a 250 square foot unit providing 31.3 watts per pound was developed and supporting analysis completed. A full scale engineering development unit was fabricated and subjected to a series of system tests consisting of deployments, deployed dynamics, stowed vibration, stowed pyrotechnic shock, stowed acoustic, and stowed and deployed thermal vacuum. Components tests of the deployable boom, thermal bending of the boom, structural tests of the blanket elements, the boom, and the bearing assembly were carried out. Author

N71-20270*# Tyco Labs., Inc., Waltham, Mass.
DEVELOPMENT OF UNIFORM AND PREDICTABLE BATTERY MATERIALS FOR NICKEL-CADMIUM AEROSPACE CELLS Quarterly Report, 8 Mar. – 7 Jun. 1970
Jun. 1970 72 p refs
(Contract NAS5-11561)
(NASA-CR-117306; QR-7) Avail: NTIS CSCL 10C

The impregnation of nickel plaque to form nickel cadmium battery plates were studied. The chemical conversion of the nitrates to the hydroxides and the Fleischer method were examined. The variables considered were solution concentration for chemical conversion, current density for the Fleischer method, and the loading for both methods. The plates were examined in terms of uniformity and reproducibility of weight gain, capacity, and utilization. It was concluded from the experimental data collected that more uniform and reproducible plates were prepared by the chemical conversion process. For the positive plates, the less concentrated impregnation solution are to be preferred. No distinction could be drawn for the negatives. Factors such as cycle life or behavior under sealed cell conditions were not included. It is also apparent from the data that uniformity and reproducibility of weight gain and capacity improve with loading, suggesting that there is a leveling effect. Utilization was found to be independent of loading up to quite high levels and plaque thickness was found to have no influence on uniformity. Plaque corrosion during impregnation was more extensive for the chemical conversion process. Author

N71-20273* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ROLL-UP SOLAR ARRAY Patent
Herman P. Valentijn, inventor (to NASA) Issued 21 Oct. 1969 (Filed 9 Nov. 1967) 7 p Cl. 244-1; Int. Cl. B64g1/10, 9/00 Sponsored by NASA
(NASA-Case-NPO-10188; US-Patent-3,473,758;
Us-Patent-Appl-SN-681687) Avail: US Patent Office CSCL 10B

A rollup solar array is described which consists of a plurality of arcuate solar panels furled on a tapered drum for spacecraft storage during launch. For space erection, the drums are rotated to extend the arcuate panels out from and around the spacecraft. An arcuate hollow beam along each panel edge stiffens the cantilevered panel. The beams are flattened as they are coiled on the drum and return to their hollow shape as they are uncoiled. Serrations in the beams avoid overstressing as the beams are flattened and opened. Official Gazette of the U.S. Patent Office

N71-20299*# Southern Methodist Univ., Dallas, Tex.
THE EFFECT OF ACOUSTIC FIELDS ON THE EFFICIENCY OF SOLAR CELLS
M. W. Wilcox and L. R. Latch 8 Mar. 1971 36 p refs
(Grant NGR-44-007-006)
(NASA-CR-117320; SMU-83-18) Avail: NTIS CSCL 10C

Tests were conducted on gallium arsenide samples which varied in resistivity due to doping. The most resistive sample (in the range of 50 megohms) showed no response due to sound input. The most efficient cell tested showed approximately 100 mV output under normal light intensity. The response to sound was relatively high but was not dependent the samples' exposure to light. Silicon solar cells were found to be totally unresponsive to sound input, with or without light exposure. Several photoresistive devices were tested but there was no indication of direct interaction of light, sound and electron motion. Author

N71-20325*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS: ACCEPTANCE TEST OF GENERAL ELECTRIC COMPANY 6.0 AMPERE HOUR NICKEL CADMIUM CELLS (CERAMIC SEALS WITH NICKEL BRAZE)
R. E. Thomas 8 Feb. 1971 22 p
(NASA Order W-12397)
(NASA-CR-117318; QE/C-71-45) Avail: NTIS CSCL 10C

The evaluation of the nickel-cadmium cells having ceramic seals with all nickel braze is described. All acceptance tests were performed at an ambient temperature between 23 C and 17 C at existing relative humidity and atmospheric pressure. Capacity, cell short, high vacuum leak, overcharge, and internal resistance test data and conclusions are included. Author

N71-20407* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
METHOD AND DEVICE FOR DETERMINING BATTERY STATE OF CHARGE Patent
Stanley J. Krause, inventor (to NASA) Issued 12 Aug. 1969 (Filed 15 Sep. 1967) 6 p Cl. 136-182; Int. Cl. H01m45/06 Sponsored by NASA
(NASA-Case-NPO-10194; US-Patent-3,460,995;
US-Patent-Appl-SN-668249) Avail: US Patent Office CSCL 10C

An indicator device is described which has at least one light emitter and light detector adjacent to each other and imbedded in a plate of a wet cell battery. The emitter is selected to emit a wavelength which can only be absorbed either by the discharge compound formed in the plate or by the charge compound formed. The detector, connected to a suitable instrument, indicates the amount of light and therefore the state of charge of the battery. Official Gazette of the U.S. Patent Office

N71-20491* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ELECTROCHEMICAL COULOMETER AND METHOD OF FORMING SAME Patent
Eugene R. Stroup, inventor (to NASA) Issued 26 Aug. 1969 (Filed 12 Sep. 1967) 4 p Cl. 136-182; Int. Cl. H01m35/18, 43/04; Int. Cl. G01r29/00
(NASA-Case-XGS-05434; US-Patent-3,463,673;
US-Patent-Appl-SN-667636) Avail: US Patent Office CSCL 10C

A coulometer cell of the secondary alkaline type is formed by flooding the cell with electrolyte. A forming current is passed in two directions through the cell with the attainment of oxygenol voltage and hydrogenol voltage in each direction. Official Gazette of the U.S. Patent Office

N71-20492* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD OF MAKING ELECTRICAL CONTACT ON SILICON SOLAR CELL AND RESULTANT PRODUCT Patent
Joseph Mandelkorn and Jacob Broder, inventors (to NASA) Issued 25 Mar. 1969 (Filed 17 May 1966) 3 p Cl. 136-89; Int. Cl. H01m13/10
(NASA-Case-XLE-04787; US-Patent-3,434,885; US-Patent-Appl-SN-551846) Avail: US Patent Office CSCL 10A

An electrode connection for a n-on-p silicon solar cell is made by depositing a layer of cerium on the surface of the cell and then depositing a layer of silver on the cerium. The solar cell with the two layers is then sintered at a temperature between 500 and 800 C. Official Gazette of the U.S. Patent Office

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N71-19400# Bureau of Radiological Health, Rockville, Md. Electronic Products Div.
ELECTRONIC PRODUCT RADIATION AND THE HEALTH PHYSICIST
Oct. 1970 470 p refs Presented at the 4th Ann. Midyear Health Phys. Soc. Topical Symp., Louisville, Ky., 28-30 Jun. 1970
(PB-195772; BRH/DEP-70-26) Avail: NTIS CSCL 06R

The Fourth Annual Midyear Topical Symposium of the Health Physics Society, cosponsored by the Blue Grass Chapter of the Society and the Bureau of Radiological Health, was held to promote exchanges of information with respect to the status, progress, and future directions in certain areas of radiation exposure. Its subject Electronic Product Radiation and the Health Physicist, encompasses a broad range of sources of exposure. Its scope extends over a large portion of the electromagnetic spectrum and includes both ionizing and nonionizing radiation. The individual presentations discuss aspects of electronic product radiation ranging from broad surveys and educational needs to specific considerations of instrumentation and biological effects. Author (GRA)

N71-19580*# Techtran Corp., Glen Burnie, Md.
THE HEART AND SPORTS: ESSAYS ON CARDIOLOGY IN SPORTS
V. L. Karpman et al Washington NASA Feb. 1971 507 p refs Transl. into ENGLISH of the book "Serdtse i Sport, Ocherki Sportivnoy Kardiologii" Moscow, Meditsina, 1968 p 1-516
(Contract NASw-1695)
(NASA-TT-F-662) Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

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N71-19581*# Techtran Corp., Glen Burnie, Md.
THE CARDIAC ACTIVITY OF ATHLETES IN THE QUIET STATE
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 2-34 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

Data on the sports heart at rest are given including properties of the cardiac muscle, pulse frequency, dimensions, cardiac output and hemodynamics circulating blood mass, infracardiac and arterial pressure, relationship between expulsion period, systolic index, cardiac rhythm and diastolic pressure in the aorta, relationship between electrical and mechanical activity of the heart, heart blood supply, and regulation of cardiac activity in athletes. Author

N71-19582*# Techtran Corp., Glen Burnie, Md.
CARDIAC ACTIVITY DURING CONDITIONS OF MUSCULAR WORK
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 35-57 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

The response of cardiodynamics to physical stress is studied. Transient cardiodynamic processes during muscular work are diagrammed and described. The alterations in cardiac rhythm, blood pressure, blood volume per beat, residual blood volume in the heart, as well as relationships between phases of the cardiac cycle as a function of physical stress level are studied. The electromechanical relationships before, during, and after physical stress are described, and the recovery period following physical stress is studied. Author

N71-19583*# Techtran Corp., Glen Burnie, Md.
BLOOD CIRCULATION AND THE STATE OF TRAINING
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 58-72 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

The leading diagnostic characteristic of the state of training is not the amplitude of the reaction to a physical load, but the type of reaction, the quality and relationships between changes in individual functional indicators. Tabular data are presented indicating the types of reaction to be expected from athletes trained for strength, speed and endurance, in various states of training, and under various physical loads. Author

N71-19584*# Techtran Corp., Glen Burnie, Md.
INVESTIGATION OF CERTAIN PARAMETERS OF CARDIO AND HEMODYNAMICS
In its The Heart and Sports: Essays on Cardiology in Sports Feb.

1971 p 74–105 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

A historical review is given of the investigatory methods used to define certain parameters of cardio- and hemodynamics. Included are: methods of investigation of cardiac output, methods of phase analysis of the cardiac contraction, particularly as used in athletes, and changes in duration of cardiac cycle phases during the performance of various physical tasks. Author

N71-19585*# Techtran Corp., Glen Burnie, Md.
ELECTRICAL MANIFESTATIONS OF CARDIAC ACTIVITY
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 106–149 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

Methods of recording and analyzing the electrical activity of the heart are analyzed. Included are classical methods of electrocardiography, as well as recent modifications and improvements, ranging from the application of new leads to improved methods of both statistical and graphical analysis. Case histories are presented to illustrate characteristics and appearance of electrocardiograms and vector cardiograms in various types of athletes with and without pathological heart problems. Author

N71-19586*# Techtran Corp., Glen Burnie, Md.
MECHANICAL MANIFESTATIONS OF CARDIAC ACTIVITY AND THE FUNCTIONAL STATE OF THE VESSELS
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 150–238 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

Methods for analysis of the mechanical manifestations of cardiovascular activity are described. Methods include phonocardiography, dynamocardiography, vector dynamocardiography, ballistocardiography, kinetocardiography, rheocardiography, tachooscillography, and various methods of sphygmography. Each method is described and diagrammed, case histories are presented, including illustrations of the various cardiograms and sphygmograms, and methods of mathematical analysis. Author

N71-19587*# Techtran Corp., Glen Burnie, Md.
X-RAY METHODS OF INVESTIGATION OF THE CARDIAC ACTIVITY OF ATHLETES
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 239–284 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

Functional X-ray methods are described for quantitative descriptions of the heart and its operation. Standard methods such as roentgenkymography are described, in addition to the recent X-ray functional method of electrokymography. Forms of roentgenkymogram rays are analyzed. Causes and manifestations of hypertrophy, principally of the left ventrical, are presented. The graphic phase analysis of electrokymograms is described, and case histories are presented. Teleroentgenography for studying heart volume is described. Author

N71-19588*# Techtran Corp., Glen Burnie, Md.
FUNCTIONAL TESTS OF THE CARDIOVASCULAR SYSTEM
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 285–314 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

Cardiovascular functional tests are analyzed: (1) dynamic tests using various physical loads, (2) orthostatic tests, and (3) tests with breath held. Attempts to design functional tests specific for the muscular activity of a given sports activity are described. Manifestations of cardiovascular pathology in response to various functional tests are described. Problems in the administration of functional tests related to time lapse between performance of functional load and measurement of cardiodynamic parameter are discussed. Author

N71-19589*# Techtran Corp., Glen Burnie, Md.
SOME METHODS OF TRANSMISSION ANALYSIS OF CARDIOLOGICAL INFORMATION IN SPORTS
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 315–349 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

Problems in cardiology are analyzed, including the problem of transmission of cardiological information over long distances without wires. The radio telemetry systems developed to perform this task are being continually improved in terms of stability, information transmission, and capacity. Automatic analysis of cardiological data is discussed. Author

N71-19590*# Techtran Corp., Glen Burnie, Md.
SOME CLINICAL PROBLEMS OF SPORTS MEDICINE
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 351–362 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06E

Factors resulting in disease in athletes are analyzed. These include changes in the external medium, improper and ineffective training, and intensive training exercises by persons with insufficient physical conditioning. The relationships between chronic centers of infection, more common in athletes than in non-athletes, and cardiac problems are explored. The importance of complete recovery from infectious diseases before resumption of sports training is emphasized. Author

N71-19591*# Techtran Corp., Glen Burnie, Md.
CHANGES IN THE ARTERIAL PRESSURE OF ATHLETES
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 363–384 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

Data available from the rather skimpy investigations into the arterial pressure of athletes are presented. It is pointed out that although arterial pressure has been measured for decades, accurate methods capable of providing reproducible results have only recently become available, and the interpretation of the results produced also varies widely. Individual differential diagnosis must be performed in all cases of abnormal arterial pressure, either high or low. Author

N71-19592*# Techtran Corp., Glen Burnie, Md.
DISRUPTIONS OF THE CARDIAC RHYTHM IN ATHLETES
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 385–402 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

The frequency and significance of arhythmias in athletes are analyzed. Case histories are presented to illustrate that many types of arhythmia frequently described as variations of the norm in the sports heart may in actuality indicate cardiac pathology. The importance of differential diagnosis of all arhythmias is emphasized. Attempts at too rapid physical training and conditioning can lead to phemenona of cardiac overstress. Case histories, electrocardiograms, and physiological explanations are presented to illustrate the significance of measured, properly applied physical exercise, undertaken only during periods of perfect health, in the prevention of cardiac pathology in athletes. Author

N71-19593*# Techtran Corp., Glen Burnie, Md.
CARDIAC OVERSTRESS IN ATHLETES
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 403–438 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

Physical overstress effects on the cardiac muscle in athletes are discussed for both acute and chronic conditions. Case histories are described and illustrated with electrocardiographic data. E.C.

N71-19594*# Techtran Corp., Glen Burnie, Md.
SYSTOLIC NOISES IN ATHLETES

In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 439–459 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

Analysis of phonocardiographic data produced under rest conditions and with various functional tests indicates that accidental systolic noise does not indicate mitral valve deficiency. The usage of phonocardiography for differential diagnosis of accidental and functional noise is described. Case histories are described and sample phonocardiograms are presented. Author

N71-19595*# Techtran Corp., Glen Burnie, Md.
ORGANIZATION OF CARDIOLOGICAL SERVICE IN SPORTS MEDICINE
In its The Heart and Sports: Essays on Cardiology in Sports Feb. 1971 p 460–500 (See N71-19580 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06E

The methodology of medical examination of athletes is based dn broad utilization of various methods allowing complete determination of the functional capacities of the organism. The cardiological service system in sports medicine includes dispenseries, periodic obligatory physical examinations of all athletes, and scientific investigations. The organization of this system is described, and needs for its future development are noted. Author

N71-19653# National Academy of Sciences-National Research Council, Washington, D.C. Committee on Oceanography.
WASTES MANAGEMENT CONCEPTS FOR THE COASTAL ZONE: REQUIREMENTS FOR RESEARCH AND INVESTIGATION
1970 135 p refs
(PB-195861; W71-01544) Avail: NTIS CSCL 13B

Scientific and engineering requirements were evaluated for research related to coastal wastes management based upon 16 background papers. The major subjects under consideration were: monitoring, chemical effects, physical effects, and biological effects. GRA

N71-19671# Randomline, Inc., Willow Grove, Pa.
BIOLOGICAL FUNCTION AS INFLUENCED BY LOW POWER MODULATED RF ENERGY
Allan H. Frey Dec. 1970 49 p refs Submitted for publication
(Contract N00014-69-C-0181)
(AD-713044) Avail: NTIS CSCL 6/18

In recent years, it has been recognized that low power density modulated rf energy can affect the functioning of higher living organisms. In this paper the sparse data generated in the western hemisphere on this subject is considered, the reasons for its sparseness noted, and the hypotheses on mechanisms that may provide an explanation for the observed effects and other possible effects are sketched. Possible conclusions with regard to hazards to personnel are then considered. Author (GRA)

N71-19720# Army Edgewood Arsenal, Md.
EXHAUSTING WORK LIMITED BY EXTERNAL RESISTANCE AND INHALATION OF CARBON DIOXIDE
F. N. Craig, W. V. Blevins, and E. G. Cummings Dec. 1970 39 p refs
(AD-716580; EA-TR-4478) Avail: NTIS CSCL 6/19

The objectives of the investigation were to find the intensities of work at which the reduction in endurance associated with inspiratory resistance would be the greatest and to test various hypotheses to account for the reduction. The following conclusions were reached: The reduction in endurance in exhausting work caused by an added inspiratory resistance is greater when the intensity is such that exhaustion is reached in from 5 to 15 minutes than when higher intensities of work lead to exhaustion in a shorter time; of the various factors examined in this report, the sense of impending exhaustion appears to be associated most closely with the reduction of the duration of expiration to a minimum value characteristic of the individual; in exhausting work, men can withstand the large elevation in alveolar carbon dioxide associated with the inhalation of carbon dioxide mixture better than the smaller but still substantial elevation in alveolar carbon dioxide associated with an added inspiratory resistance. Author (GRA)

N71-19783*# Missouri Univ., Columbia. Medical School.
THE ECOLOGY OF THE INTESTINAL FLORA IN A CHANGING ENVIRONMENT Final Report
T. D. Luckey 8 Feb. 1971 12 p refs
(Contract NAS9-10765)
(NASA-CR-114889) Avail: NTIS CSCL 06M

Background information and topics discussed at a symposium on the ecology of the intestinal flora in a changing environment are summarized including resulting publications and recommendations. J.M

N71-19813# Goodyear Aerospace Corp., Akron, Ohio.
WHOLE BODY AND BARE HAND COOLING AT HIGH WIND SPEEDS Final Report, Dec. 1968–Jun. 1970
Richard A. Wilson, Kenneth Easter, Harold E. Kerber, Paul Webb, and James F. Annis Wright-Patterson AFB, Ohio AMRL Sep. 1970 109 p refs Prepared in cooperation with Webb Associates
(Contract F33615-69-C-1063)
(AD-715976; GER-14780; AMRL-TR-70-39) Avail: NTIS CSCL 6/19

Men were exposed in a wind tunnel with their backs to the wind, speeds 0 to 110 mph, at ambient temperatures of 21.1C (70F) to –31.7C (–25F) while hanging in a parachute harness clothed in Air Force flight suits at a simulated altitude of 600 feet. In summer flight suits exposures at 100 mph, –1.1C (30F) for 20 minutes following a standard precool of 10 minutes at 10 mph, were tolerated without frostbite. In winter flight suits, after precool at chosen ambient, men withstood 100 mph at –9.4C (15F) for 20 minutes and –17.8C (0 F) for 6.3 minutes. The latter test was terminated when skin on the calf reached the predetermined safety limit of 0 C (32F). At –17.8C (0 F) full 20-minutes exposure was tolerated at 50 mph. Considerable discomfort but no tissue cold damage attended the coldest runs when mean weighted skin temperatures fell as low as 16C (60.8F). Rectal temperatures rose slightly then started down near the end of each 30 minute test run. Skin temperatures measured with embedded thermocouples during direct bare hand exposures correlate well with Siples low speed windchill data; and both provide excessively conservative exposure criteria for well clothed man. Clothed full body exposure data establish a conservative basis for estimating thermally safe temperature-wind speed regimes for towing men during air-to-air rescue maneuvers. Author (GRA)

N71-19876*# General Technical Services, Inc., Upper Darby, Pa.
INTRODUCTION TO A BIOLOGICAL SYSTEMS SCIENCE
E. Bloch (Case Western Reserve Univ.), S. Cardon, A. Iberall, D. Jacobowitz (Pa. Univ.), K. Kornacker (Ohio State Univ.) et al Washington NASA Feb. 1971 332 p refs Sponsored in part by AROD
(Contract NASw-1815)
(NASA-CR-1720) Avail: NTIS HC$6.00/MF$0.95 CSCL 06C

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9. A PHYSICAL VIEW OF METABOLIC SYSTEMS: THE BIOCHEMICAL TRANSITION FROM ORGAN SYSTEMS TO THE HIGHER CENTRAL NERVOUS SYSTEM p 198-229 refs (See N71-19885 09-04)

10. THE ROLE OF THE NERVOUS SYSTEM IN THE ORGANIZATION AND INTEGRATION OF LIVING SYSTEMS p 230-293 refs (See N71-19886 09-04)

11. THE CHEMICAL ORIGINS OF MAMMALIAN BEHAVIOR p 294-318 refs (See N71-19887 09-04)

12. SUMMARY, OVERVIEW, AND DISCUSSION p 319-327 ref (See N71-19888 09-04)

N71-19877*# General Technical Services, Inc., Upper Darby, Pa.
INTRODUCTION TO A BIOLOGICAL SYSTEMS SCIENCE: PRELIMINARIES
In its Introduction to a Biol. Systems Sci. Feb. 1971 p 1-23 refs (See N71-19876 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06C

Biological systems analysis is used to determine, within a hierarchical level, what relations govern time scheduled behavior during start-up, life, and degradation. The operative principle is used to design the major system components that perform high frequency functions and to combine ancillary components in assembling the overall biological system so that it meets life requirements. G.G.

N71-19878*# General Technical Services, Inc., Upper Darby, Pa.
THE ORGANIZING PRINCIPLE OF COMPLEX LIVING SYSTEMS
In its Introduction to a Biol. Systems Sci. Feb. 1971 p 24-36 refs (See N71-19876 09-04)
Avail: NTIS HC$6.00/MF $0.95 CSCL 06C

Physiological and behavioral mechanisms are considered in designing a human biosystem of dynamic oscillatory characteristics. Long term behavior is represented by the continued effort to shift internal state patterns in order to bring them into concordance with an image ideal that represents an abstract pattern of internal physical-chemical states. G.G.

N71-19879*# General Technical Services, Inc., Upper Darby, Pa.
HIERARCHICAL REGULATION IN THE COMPLEX BIOLOGICAL ORGANISM
In its Introduction to a Biol. Systems Sci. Feb. 1971 p 37-49 refs (See N71-19876 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06C

Hierarchical organized complexes found within man are discussed. Considered are: (1) process maintenance and exchange at the cellular level; (2) internal process organization and logic for the macrosystem; and (3) factory operation of the biosystem in its total environment. The gross system and its dynamic responses are evaluated for steady and transient states by determining times and spatial courses of the major identified fluxes and potentials, and the modes of motor actions that the system exhibits. A homeokinesis model is formulated that achieves metabolic regulation by dynamic overlay of level upon level of behavioral performance. G.G.

N71-19880*# General Technical Services, Inc., Upper Darby, Pa.
SUMMARY OF SOME OF THE ABSTRACT PRINCIPLES FOR A BIOSYSTEMS SCIENCE
In its Introduction to a Biol. Systems Sci. Feb. 1971 p 50-55 refs (See N71-19876 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06C

Summarized are the fundamental principles for forming bioscience models: (1) homeokinesis; (2) spatial and temporal biospectroscopy; (3) system instability; (4) behavioral modalities; and (5) hierarchical regulation. G.G.

N71-19881*# General Technical Services, Inc., Upper Darby, Pa.
AN INTRODUCTION TO STRUCTURES AT THE LOWER LEVELS OF ORGANIZATION
In its Introduction to a Biol. Systems Sci. Feb. 1971 p 56-75 refs (See N71-19876 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06C

The dynamic nature of active transport at the membrane level is clarified by forming functional models for the relationships between nucleic acid polymers and protein synthesis. Informational and functional substances contained in cell membranes are outlined and their effects on molecular transport modes and mechanisms are discussed. G.G.

N71-19882*# General Technical Services, Inc., Upper Darby, Pa.
SOME COMMENTS ON CONTROL OF THE MICROVASCULAR SYSTEM
In its Introduction to a Biol. Systems Sci. Feb. 1971 p 76-112 refs (See N71-19876 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

Some aspects of the role of the microvascular system in maintaining homeokinesis of the whole animal, i.e., in man and other vertebrates are examined. Particular emphasis is placed on: (1) the dynamics of form (the morphokinesis of the system); (2) the mechanisms that have been suggested for controlling the system (the dynamics of function) with their attendant successes and problems; and (3) recommendations for experiments that may further elucidate the control mechanisms. Author

N71-19883*# General Technical Services, Inc., Upper Darby, Pa.
THOUGHTS CONCERNING AUTONOMIC NERVOUS SYSTEM CONTROLLING INFLUENCES
In its Introduction to a Biol. Systems Sci. Feb. 1971 p 113-129 refs (See N71-19876 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

Physiological actions that suggest peripheral autonomic controlling effects on the nervous system are studied. Ganglia are considered as isolated little brains displayed from the CNS to the periphery where their physiological functions provide electrical dynamic impulses. Biological action and interaction models for ganglia and organ and cardiovascular system control mechanisms are depicted. G.G.

N71-19884*# General Technical Services, Inc., Upper Darby, Pa.
THE CARDIOVASCULAR SYSTEM
In its Introduction to a Biol. Systems Sci. Feb. 1971 p 130-197 refs (See N71-19876 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

Biological models for cardiac and vascular functions are developed by evaluating cardiovascular system responses to rest and exercise parameters. A steady state algebraic model is used to compute functional curves of the parametric alterations contained in blood flow, oxygen consumption, and metabolism of the mammalian CV system. G.G.

N71-19885*# General Technical Services, Inc., Upper Darby, Pa.
A PHYSICAL VIEW OF METABOLIC SYSTEMS: THE BIOCHEMICAL TRANSITION FROM ORGAN SYSTEMS TO

THE HIGHER CENTRAL NERVOUS SYSTEM
In its Introduction to a Biol. Systems Sci. Feb. 1971 p 198–229 refs (See N71-19876 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06P

General aspects of cellular metabolic bioenergetic systems are developed and used to interpret human and plant behaviors in which repetitive metabolic performances are achieved by the flow of chemical signals. Oscillatory, limit-cycle chemical systems govern biological processes at primitive levels; hormonal messengers provide the coupling between metabolic processes and environmental factors and affect protein synthesis. It is concluded that periodic performances of metabolic systems appear at the lowest level of an organization that meets the criteria of life; a single hormone controls processes occurring in multiple time domains. Hierarchical bioenergetic mechanisms affected by hormones involve biochemical chains, membrane transports and the microcirculation in animals. For man the prime mover of the metabolic system is the willing into action of skeletal muscle masses with the resulting consumption of oxygen, glucose, and fatty acids followed by the adoption of new states through commands issued by intracellular signals, metabolites, tissue substances released locally, neural transmitters, and hormones. G.G.

N71-19886*# General Technical Services, Inc., Upper Darby, Pa.
THE ROLE OF THE NERVOUS SYSTEM IN THE ORGANIZATION AND INTEGRATION OF LIVING SYSTEMS
In its Introduction to a Biol. Systems Sci. Feb. 1971 p 230–293 refs (See N71-19876 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06C

Various biological models are formed that illustrate the regulatory mechanisms of cellular activities by specific enzymes which themselves are specified by the genetic apparatus of the cell from information stored within the cell's DNA. Modifications of the cell's structure are regulated by the relative rate of synthesis for each possible enzyme. The nervous system evaluates stimuli and triggers the regulatory enzymatic activities that are necessary. G.G.

N71-19887*# General Technical Services, Inc., Upper Darby, Pa.
THE CHEMICAL ORIGINS OF MAMMALIAN BEHAVIOR
In its Introduction to a Biol. Systems Sci. Feb. 1971 p 294–318 refs (See N71-19876 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06A

The effects of hormonal-metabolic states on human and mammalian behaviors are discussed. Metabolic component levels in blood, hormonal levels and times of action, and human behavior are correlated to form a matrix whose columns represent chemical materials, chemical process changes, hormonal and behavioral modes, and whose rows show discrete time intervals. Couplings may take place between hormones and processes or components or among the components and processes themselves. G.G.

N71-19888*# General Technical Services, Inc., Upper Darby, Pa.
SUMMARY, OVERVIEW, AND DISCUSSION
In its Introduction to a Biol. Systems Sci. Feb. 1971 p 319–327 ref (See N71-19876 09-04)
Avail: NTIS HC$6.00/MF$0.95 CSCL 06C

Principles by which complex biosystems can be defined within physical and biological contexts are: (1) homeokinesis; (2) spatial and temporal biospectroscopy; (3) system instability; (4) behavioral modalities; and (5) hierarchial regulation. These dynamic systems are used to formulate biological models for membrane activities, the microvasculature, the nervous autonomic system, the biochemical chains, the higher nervous structure and function, and the hormonal effects on behavior. G.G.

N71-19917# Public Health Service, Las Vegas, Nev. Southwestern Radiological Health Lab.
ENVIRONMENTAL SURVEILLANCE FOR PHOEBUS 2A REACTOR TEST SERIES Final Report, May–Jul. 1968
Oct. 1970 54 p refs
(AEC Order SF-54-373)
(SWRHL-72-r) Avail: NTIS

The Phoebus 2A nuclear reactor was tested through five Experimental Plans (EP's) at Test Cell C. Radiological monitoring and environmental sampling in off-site areas surrounding the Test Range Complex were conducted. During EP 3, 4, and 5, the reactor was operated at power levels near 2000, 4000, and 4000 MW, respectively, releasing airborne radioactivity which was detected in off-site areas. As a result of these tests, some radioactive contamination occurred off-site which was detected in air and vegetation samples collected following the three tests and additionally in milk and cow feed samples collected for EP 4 and 5. The maximum external radiation exposure measured off-site following EP 5 was less than 0.1 mR at Queen City Summit, an unpopulated area. The maximum postulated absorbed dose to the thyroid of a child with a 2-g thyroid was 13 mRad at Blue Eagle Ranch following EP 5. These doses were below radiation protection standards. Author (NSA)

N71-20010# Atomic Energy Commission, Oak Ridge, Tenn.
SYMPOSIUM ON NEUTRONS IN RADIOBIOLOGY
[1969] 596 p refs Conf. held at Oak Ridge, Tenn., 11–14 Nov. 1969; sponsored by Tenn. Univ.-AEC Agr. Res. Lab. and ORNL
(CONF-691106) Avail: NTIS HC$6.00/MF$0.95

Papers are presented from the symposium on neutrons in radiobiology which are devoted to neutron dosimetry and biophysics, relative biological effectiveness, genetic effects, repair and recovery, and modifying factors. Although there were no papers devoted entirely to therapy, various parameters were examined from the standpoint of utilizing neutrons in human cancer therapy. J.M.

N71-20076# Advisory Group fo Aerospace Research and Development, Paris (France).
GLOSSARY OF AEROSPACE MEDICAL TERMS, ENGLISH-FRENCH AND FRENCH-ENGLISH [GLOSSAIRE DES TERMES UTILISES EN MEDECINE AEROSPATIALE, ANGLAIS-FRANCAIS ET FRANCAIS-ANGLAIS]
D. I. Fryer, ed. Jan. 1971 54 p ref In ENGLISH and FRENCH Revised
(AGARD-AG-153-71; AGARDOGRAPH-153) Avail: NTIS

A glossary of new terms is presented by the AGARD Aerospace Medical Panel. The terms are limited to those having a specific meaning in Aerospace Medicine or peculiar to that field of study. Author

N71-20113*# Matrix Corp., Alexandria, Va. Human Factors Div.
EFFECTS OF NOISE AND VIBRATION ON COMMERCIAL HELICOPTER PILOTS. RESULTS OF PHASE 1 RESEARCH Final Report
Thomas B. Malone, George A. Schweickert, Jr., and James M. Ketchel 7 Apr. 1970 101 p refs
(Contract NASw-1829)
(NASA-CR-117181) Avail: NTIS CSCL 06P

The effects of appropriate noise and vibration levels on commercial helicopter pilots are discussed including effects on pilot safety, on pilot performance, and on pilot comfort. It is concluded that noise levels expected in commercial helicopters do pose a problem for the pilot since they generally exceed accepted damage risk limits, although no findings were identified which demonstrate long term or chronic effects of vibration on pilot physical condition. Author

N71-20148# Defence Research Establishment Toronto, Downsview (Ontario).

EFFECT OF COLD EXPOSURE ON THE HOMING PERFORMANCE OF TRAINED PIGEONS

S. D. Livingstone and E. D. L. Topliff Sep. 1970 6 p refs
(DRET-723) Avail: NTIS

Homing pigeons, trained over increasing distances up to a maximum of 56 kilometers, were exposed intermittently to cold for a total duration of 132 hours. Concurrently a trained control group of similar size, paired by age with the test group, was kept at 24 C ambient temperature. After the period of exposure was complete both groups were flown over the 56 kilometer distance of the training course and their individual times to home were recorded. All birds returned to the coop. A significant impairment of homing performance was observed in the cold exposed birds relative to that of the controls. Author

N71-20160*# Techtran Corp., Glen Burnie, Md.

THE METHOD OF DETERMINING THE INGESTIVE AND DIGESTIVE CAPABILITY OF NEUTROPHILS [K METODIKE OPREDELENIYA POGLOTITELNOY I PEREVARIVAYUSHCHEY SPOSOBNOSTI NEYTROFILOV]

A. I. Ivanov et al Washington NASA Mar. 1971 7 p refs Transl. into ENGLISH from Lab. Delo (Moscow), no. 10, 1967 p 610–613
(Contract NASw-2037)
(NASA-TT-F-13553) Avail: NTIS CSCL 06M

A modification of the Berman–Sivaskaya method is described for determining the digestive capability of neutrophils. Phagocytized microbial cells were cultivated on a medium of meat-peptone broth for 45 minutes after an initial incubation of the bacteria and blood mixture for 30 minutes at 37 C. A broth to blood ratio of 1:1 or 2:1 eliminated the necessity for preliminary centrifuging. The method described permits determination of the percent of phagocytosis, phogocytic number, phagocytic index, index of digestion, and also, in the presence of a leucocytic formula, the total number of ingested and digested microorganisms in 1 cu mm of blood. Author

N71-20165*# Naval Aerospace Medical Inst., Pensacola, Fla.

A TECHNIQUE FOR PRODUCING CALISTHENIC BEHAVIOR IN A RHESUS MONKEY

John de Lorge 1 Dec. 1970 16 p refs
(NASA Order L-43518)
(NASA-CR-117308; NAMRL-1124) Avail: NTIS CSCL 06C

A technique for exercise to counteract the effect of zero gravity on skeletal muscles in unrestrained monkeys during extended orbital spaceflight was explored. A rhesus monkey was reinforced with both food and food-associated stimuli for making a high-effort response continuously for 3 to 4 hours. Various manipulations of the frequency of food reinforcement and signals indicating the availability of food were used to evaluate the effect of each on the exercise response and associated behavior. The technique satisfactorily maintained exercise for up to 3 hours. A 50-percent reduction in the density of food reinformcement reduced exercise response rates by less than 25 percent. Removal of a signal that indicated the nonavailability of food had no significant permanent effects but did lead to a small increment in the exercise response rate. Presenting signals similar to the one that indicated food availability merely confused the animal and drastically lowered the exercise response rate. Author

N71-20169*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

SURVIVAL OF ANTARCTIC DESERT SOIL BACTERIA EXPOSED TO VARIOUS TEMPERATURES AND TO THREE YEARS OF CONTINUOUS MEDIUM-HIGH VACUUM

R. E. Cameron and H. P. Conrow 1 Feb. 1971 10 p refs
(Contract NAS7-100; Grant NSF C-585)
(NASA-CR-117313; JPL-TR-32-1524) Avail: NTIS CSCL 06M

Samples of cold desert soil containing viable bacteria from McKelvey dry valley, Southern Victoria Land, Antarctica were subjected to 3 years of continuous medium-high vacuum of 0.001 to 0.0001 torr at room temperature and storage for 4 years at −30, −5, +5, and +20 C. Dependent upon storage temperatures, the survivability of bacteria decreased with increase in temperatures, with only 3 bacteria/g of soil surviving at room temperature in vacuum, and 500 bacteria/g of soil surviving storage at −30 C. Corynebacterium sp., a soil diphtheroid, constituted approximately 90% of the surviving populations. Arthrobacter spp. and a Micrococcus sp. also survived, but no Bacillus spp. survived in any of the samples, although they were present in the soil when it was cultured soon after collection. The reduction in abundance and kinds of bacteria from this naturally harsh terrestrial environment is relevant to the importance of storage conditions for return of Martial soil samples. Based upon Antarctic soil microbial ecology as a Mars model, the most likely life forms for a Martial cold desert soil ecosystem are diphtheroid-like microorganisms. Author

N71-20172*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

GROWTH OF BACTERIA IN SOILS FROM ANTARCTIC DRY VALLEYS

R. E. Cameron (JPL) and E. L. Morelock Pasadena, Calif. JPL 1 Feb. 1971 17 p refs
(Contract NAS7-100)
(NASA-TM-X-66965; JPL-TR-32-1522) Avail: NTIS CSCL 06M

Microbial response was studied in four cold desert surface soils following moist soil incubation. Soils were typical Antarctic dry valley saline sands, low in organic matter content and low in sbundances and kinds of viable microorganisms. Moist soil incubation increased the viable counts of three of the four soils. Most of the bacteria could grow at temperatures of 8 C; however, they grew mpre rapidly at 25 C. Failure of isolants from three of the soils to grow in sea salts medium indicated that they were probably not marine contaminants. It is suggested that the organisms in the three soils are probably indigenous organisms. They have adapted to the cold desert Antarctic terrestrial ecosystem, which provides a soil microbial ecology as a Mars model. Author

N71-20178# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

RADIOSENSITIVITY OF THE SWISS-RAP MOUSE AS A FUNCTION OF ITS GROWTH RATE [RADIOSENSIBILITE DE LA SOUCHE DE SOURIS SWISS-RAP EN FONCTION DE SON TAUX DE CROISSANCE]

Gerard Legeay and Jean-Francois Glas Apr. 1969 16 p refs In FRENCH
(CEA-R-3797) Avail: AEC Depository Libraries

The results are reported from an exhaustive study of the age-dependence of the gamma-radiosensitivity of female Swiss-Rap mice. A close relation between radiosensitivity and age could not be demonstrated, whereas the weekly growth rate could be accurately related to radiosensivity. Thus, the latter should be studied when this strain is to be used for biological experiments. The rates of growth differ with the strain of mice. Author (NSA)

N71-20179*# Scripta Technica, Inc., Washington, D.C.

EFFECT OF LITHIUM AND CALCIUM IONS ON THE ACETYLCHOLINESTERASE ACTIVITY OF ERYTHROCYTES [VLIYANIYE IONOV LITIYA I KALTSIYA NA AKTIVNOST ATSETILKHOLINESTERAZY ERITROTSITOV]

A. P. Brestkin et al NASA Mar. 1971 7 p refs Transl. into ENGLISH from Biokhimiya (Moscow), v. 35, no. 4, 1970 p 652–656
(Contract NASw-2036)
(NASA-TT-F-13476) Avail: NTIS CSCL 06C

A study was made of the effect of LiCl and CaCl2 on the hydrolysis rate of acetylcholine under the action of acetylcholinesterase from bovine erythrocyte stroma at pH 7.8 and

37 C. It was found that in a relatively small concentration (0.05N) these salts activate the enzyme reaction to the same extent, the activation increasing with an increase in the salt concentration up to 0.1 N. The shape of the kinetic curves, plotted in the coordinate system initial reaction rate vs. substrate concentration(s), does not differ substantially from the shape of the control curve when these salts are not present. At very high salt concentrations (1.5 and 3.0 N) the effect of the salts has a different character; at small values of s on inhibition, and at high s values an activation of the reaction is observed. A substrate inhibition is not observed in this case. A discussion of the observed effects is given, based on the assumption of a change in the structure of the active surface of the enzyme molecule under the influence of these salts. Author

N71-20187*# Scientific Translation Service, Santa Barbara, Calif.
BIOASTRONAUTICS AND EXTRATERRESTRIAL LIFE [BIOASTRONAUTICA Y VIDA EXTRA TERRESTRE]
Horacio Marco Moll Washington NASA Mar. 1971 20 p Transl. into ENGLISH from Rev. de Aeron. y Astronautica (Madrid), v. 30, no. 358, Sep. 1970 p 663–673
(Contract NASw-2035)
(NASA-TT-F-13467) Avail: NTIS CSCL 06B

Consideration of biological exploration of space as a possible means of determining the origin of life on the earth. Russian and American experiments with probes and satellites are briefly outlined, and attention is given to the possibility of life on Venus, Mars, and Jupiter. The possibilities of extraterrestrial life are closely related to profound structural changes of life material which, on those planets, has adapted to the environmental conditions which are different from those on earth. Author

N71-20204# General Electric Co., Philadelphia, Pa. Environmental Sciences Lab.
CONTAMINATION STUDIES IN A SPACE SIMULATED ENVIRONMENT
David L. Enlow *In* NBS Space Simulation Oct. 1970 p 51–77 refs (See N71-20201 09-11)
Avail: SOD $5.25

Biological and optical contamination problems can be best investigated experimentally. Studying the dynamics of microorganisms in a vacuum environment showed that shock forces in the order of a 1000 g's will liberate 20 percent of the previously bound particles and the effect of simulated attitude control gas jet firing will remove more than 50 percent of the bound particles. A potential source for optical degradation to infrared systems is identified as the absorption phenomena of condensed volatile products from certain polymeric materials. The effects of this condensation were analyzed by a combination of surface photography and IR spectroscopy. Author

N71-20205# General Electric Co., Philadelphia, Pa. Space Div.
EXTERNAL SPACECRAFT CONTAMINATION MODELING AND COUNTERMEASURES
Theodore Baurer, M. H. Bortner, Irwin M. Pikus, and Arnold M. Cooper (Grumman Aerospace Corp.) *In* NBS Space Simulation Oct. 1970 p 79–103 refs (See N71-20201 09-11)
Avail: SOD $5.25

The problem of spacecraft external contamination is a function of both the spacecraft and the receptors, in relation to the natures and quantities of contaminants involved, i.e., the problem depends on both design and mission. The relevant phenomenology may be conceptualized in a model which assumes that a mass transfer mechanism is operative, including sources, transport modes, and sinks. Typical sources include engine debris, jettisoned wastes, outgassing, and cabin leakage. Impacting particulates adhere or scatter at the dielectric surface depending on the relative magnitudes of local surface potential, strength of induced dipoles, and particle velocity vectors normal to the surface. This model suggests approaches to the problem of counteracting contamination, viz., passive prevention, active removal measures during the transport of contaminants and means of counteracting or discounting the effects of contaminants. Author

N71-20286*# Sandia Corp., Albuquerque, N.Mex.
THE PREPARATION AND ASSAY OF T4 BACTERIOPHAGE
Ralph E. Trujillo Feb. 1971 17 p refs
(NASA Order W-12853)
(NASA-CR-117172; SC-RR-710107) Avail: NTIS CSCL

A method is described for the preparation and assay of T4 bacteriophage in which the process of phage infection, multiplication, and subsequent bacterial host cell lysis serve as the basis for the procedure. The description is of sufficient detail to allow persons unfamiliar with virology techniques to successfully utilize and study the phage system. Author

N71-20351# Advisory Group for Aerospace Research and Development, Paris (France).
ADAPTATION AND ACCLIMATISATION IN AEROSPACE MEDICINE
H. J. Grunhofer, ed. Mar. 1971 202 p refs Presented at 27th Aerospace Med. Panel Meeting, Garmish-Partenkirchen, West Germany, 14–18 Sep. 1970
(AGARD-CP-82-71) Avail: NTIS

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5. VIBRATION IN V/STOL AIRCRAFT W. L. Jones (NASA, Washington, D.C.) 10 p refs (See N71-20356 09-04)

6. EFFECT OF POSTURE ON TOLERANCE TO POSITIVE (G sub z) ACCELERATION R. J. Crossley and D. H. Glaister (Royal Air Force Inst. of Aviation Medicine, Farnborough, England) 8 p refs (See N71-20357 09-04)

7. EFFECTS OF POSITIVE Gy ACCELERATION ON BLOOD OXYGEN SATURATION AND PLEURAL PRESSURE RELATIONSHIPS IN DOGS BREATHING FIRST AIR, THEN LIQUID FLUOROCARBON IN A WHOLE BODY WATER IMMERSION RESPIRATOR D. J. Sass, E. L. Ritman, P. E. Caskey, J. Greenleaf, and N. Banchero et al (Mayo Clinic) 15 p refs (See N71-20358 09-04)

8. AGE AND EXERCISE AS FACTORS INFLUENCING OSTEOPOROSIS, BONE STRENGTH, AND ACCELERATION TOLERANCE L. E. Kazarian and H. E. Von Gierke (AMRL) 21 p refs (See N71-20359 09-04)

9. PROBLEMS OF ADAPTATION TO LONG RANGE LARGE SCALE AERIAL TROOP DEPLOYMENT S. C. Knapp (Army Aeromedical Research Lab.) 14 p refs (See N71-20360 09-04)

10. IMPULSIVENESS AND ANXIETY RELATED TO PERCEPTUAL MOTOR PERFORMANCE E. S. Barratt (Texas Univ., Galveston) and G. Tolhurst (ONR, Arlington, Va.) 5 p refs (See N71-20361 09-04)

11. EFFECTS ON HUMAN PERFORMANCE OF COMBINED ENVIRONMENTAL STRESSES W. F. Grether (AMRL) 10 p refs (See N71-20362 09-04)

12. THE NOVEL TASK AS A MEASURE OF PERFORMANCE UNDER ENVIRONMENTAL STRESS M. F. Allnutt (Royal Air Force

Inst. of Aviation Medicine, Farnborough, England) 4 p refs (See N71-20363 09-04)

13. IS LABORATORY EXPERIMENTATION USEFUL FOR STUDYING HUMAN ADAPTATION TO UNINHABITABLE SENSORY ENVIRONMENTS? R. Angiboust (Centre D'Enseignement Et De Recherches De Medecine Aeronautique, Paris, France) 7 p (See N71-20364 09-04)

14. THE PSYCHOTHERAPEUTIC METHOD IN AVIATION PSYCHIATRY IN THE TREATMENT OF SOME SYNDROMES OF A REACTIVE CHARACTER L. Longo (Italian Air Force Psycho-Phsiological Inst., Naples) 10 p refs (See N71-20365 09-04)

15. EXPERIMENTAL RESEARCH ON HEAT BALANCE OF ATHLETES OF VARIOUS SPECIALTIES, DURING MUSCULAR EXERCISE IN DIFFERENT THERMAL ENVIRONMENTS P. Rota (Italian Air Force Aerospace Medical Center, Rome, Italy) and A. Todaro (Accident Prevent. Natl. Agency Res. Center) 8 p refs (See N71-20366 09-04)

16. ENERGY METABOLISM DURING EXPOSURE TO EXTREME ENVIRONMENTS C. F. Consolazio, H. L. Johnson and H. J. Krzywicki (Army Medical Research and Nutrition Lab.) 11 p refs (See N71-20367 09-04)

17. METABOLIC IMBALANCES AND BODY HYPOHYDRATION DURING FOOD DEPRIVATION (10 DAYS) C. F. Consolazio, H. L. Johnson, and H. J. Krzywicki (Army Medical Research and Nutrition Lab.) 8 p refs (See N71-20368 09-04)

18. THE INFLUENCE OF ENVIRONMENTAL FACTORS IN AIRCRAFT CARRIER LANDINGS AND ACCIDENTS C. A. Brictson (Dunlap and Associates, Inc., Santa Monica, Calif.) 7 p refs (See N71-20369 09-02)

19. EFFECT OF ACUTE AND CHRONIC EXPOSURE TO 21 MM HG AMBIENT P SUB CO2 ON EXERCISE RESPONSE OF NORMAL MAN R. D. Sinclair, J. M. Clark, and B. E. Welch (School of Aerospace Medicine) 9 p refs (See N71-20370 09-04)

20. VOLITIONAL CONTROL OF VISUAL ACCOMMODATION R. J. Randle (NASA, Ames Research Center, Moffett Field, Calif.) 13 p refs (See N71-20371 09-04)

N71-20352# Office of Naval Research, Arlington, Va.

ACCOUSTIC FATIGUE OF HUMANS EXPOSED TO NOISE

Gilbert C. Tolhurst *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 8 p refs (See N71-20351 09-04)
Avail: NTIS

Since human fatigue is not truly a precise phase, by borrowing an analogy from the material sciences, an attempt has been made to outline both physiologically and psychologically the limits and ranges of the response to acoustic stimuli, termed elasticity, deformation and destruction. The precision is no better or no worse than the same terms applied to metal fatigue. Present damage-risk criteria, if strictly applied by industry, the military, or by social services organizations, should materially reduce the incidence of noise induced hearing losses to approximately 85 to 95 percent of a population. Considerable amounts of data are needed to allow any particular individual's susceptibility to be predicted with precision. While considerable research effort has yielded ever increasingly elegant methods to quantify potentially hazardous noise environments, as well as communications interferring ones, the consequences of prolonged noise exposure need extensive experimental validation. Author

N71-20353# Army Medical Research Lab., Fort Knox, Ky. Experimental Psychology Div.

GROWTH AND RECOVERY OF TEMPORARY THRESHOLD SHIFTS FOLLOWING EXTENDED EXPOSURE TO HIGH LEVEL, CONTINUOUS NOISE

James D. Mosko and John L. Fletcher *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 7 p refs (See N71-20351 09-04)
Avail: NTIS

Requirements of long term operations for both air and ground military personnel have increased in recent years, and the probability of having such personnel exposed to hazardous noise levels and durations has increased. Research was undertaken to investigate the effects of long term exposure on the auditory thresholds for discrete tonal signals and the recovery from any temporary threshold shift. Evidence indicates a gradual growth in temporary threshold shift (TTS) over 12 – 16 hours of exposure, with an asymptotic TTS configuration extending through 48 hours of exposure. Full recovery is attained in approximately 23 – 24 hours after cessation of exposure. The results of this research could lead to reconsideration of the damage risk criteria for noise exposure, and to the design of protective devices. Author

N71-20354# Randomline Inc., Willow Grove, Pa.

CARDIAC AND NEURAL EFFECTS OF RADAR WAVELENGTHS

Allan H. Frey *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 8 p (See N71-20351 09-04)
Avail: NTIS

Results of experimentation on the cardiac effects of UHF energy are reviewed. A series of three experiments were conducted, the first two experiments used isolated frog hearts and the third used intact frogs. The UHF energy was synchronized with events in the ECG in an attempt to drive the heart. Synchronization with the R wave had significant effects. Author

N71-20355# Matrix Corp., Alexandria, Va.

FLIGHT CREW ADAPTABILITY TO THE HELICOPTER VIBRATION ENVIRONMENT

J. W. Danaher *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 5 p refs Sponsored by ONR (See N71-20351 09-04)
Avail: NTIS

Interpretations of research literature concerning the effects of vibration on man are presented. Described are some effects of vibration on the performance of certain flight crew tasks required by emerging helicopter missions. Specifically, the implications for long duration, search and rescue, and assault support missions are discussed. Tasks associated with the operation of various human sensory systems, digital input devices, and helmet-mounted and other displays are also analyzed. Areas requiring further research are defined and engineering approaches to the solution of the helicopter vibration problem are outlined. Author

N71-20356*# National Aeronautics and Space Administration, Washington, D.C.

VIBRATION IN V/STOL AIRCRAFT

Walton L. Jones *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 10 p refs (See N71-20351 09-04)
(NASA-TM-X-66956) Avail: NTIS CSCL 06S

The ride comfort program being conducted at Langley Research Center is described. This program assesses those characteristics of V/STOL vibration which influence human comfort. Vehicle measurements correlated with the results from simulation experiments will yield the recommended ride comfort criteria. Also described is: (1) a planned study of an active vibration isolation system designed to eliminate approximately 90% of the vibration at the primary frequency of 18 cycles per second; and (2) a ride comfort simulator having three degrees of freedom, a payload capacity of 5,000 pounds, and vertical and lateral direction having peak-to-peak double amplitude of six inches with plus and minus 0.5 g. A.L.

N71-20357# Royal Air Force Inst. of Aviation Medicine Farnborough (England).

EFFECT OF POSTURE ON TOLERANCE TO POSITIVE (Gz) ACCELERATION

R. J. Crossley and D. H. Glaister *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 8 p refs (See N71-20351 09-04)
Avail: NTIS

The effect of varying the posture of eight subjects on their relaxed greyout thresholds has been studied. Six angles of the seat back between 70 deg to the horizontal and 15 deg, and rates of onset of acceleration of 1.0 g/sec and 0.1 g/sec were used. The g thresholds of all subjects, with both rates of onset, increased as the back angle decreased and were directly proportional to the reciprocal of the vertical distance between the eye and the haemodynamic indifference point. The degree of neck flexion was observed to have little effect on the thresholds at any one angle. Four subjects also wore an anti-g suit for further threshold determinations with seat back angles of 70 deg, 30 deg and 15 deg. The increase in thresholds produced by the anti-g suit was the same for each angle. Comparison of the thresholds observed with the two rates of onset show that the 0.1 g/sec rate leads to higher thresholds than the 1.0 g/sec rate. These studies indicate that a near-supine posture combined with an anti-g suit can provide relaxed g thresholds in the region of 6 to 8 g while permitting adequate forward vision. Such a posture would have the added advantage of exposing the aircrew to +g sub x acceleration during ejection. Author

N71-20358*# Mayo Clinic, Rochester, Minn. Graduate School of Medicine.

EFFECTS OF POSITIVE Gy ACCELERATION ON BLOOD OXYGEN SATURATION AND PLEURAL PRESSURE RELATIONSHIPS IN DOGS BREATHING FIRST AIR, THEN LIQUID FLUOROCARBON IN A WHOLE BODY WATER IMMERSION RESPIRATOR

D. J. Sass, E. L. Ritman, P. E. Caskey, J. Greenleaf, N. Banchero et al *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 15 p refs Sponsored in part by Navy (See N71-20351 09-04)
(Grant NGR-24-003-001; Contract F41609-69-C-0058; Grant NIH HE-3532)
(NASA-CR-117199) Avail: NTIS CSCL 06S

A total body water immersion, mechanical respiration, body support assembly has been used with dogs on the human centrifuge to compare effects of +1 Gy and +6 Gy acceleration on cardiovascular and respiratory function in dogs under three conditions: (1) normal respiration in air; (2) totally immersed in a saline-filled respirator chamber providing control of respiratory rate, tidal and residual volumes when breathing air or oxygen; and (3) when respired in the same manner with oxygenated liquid fluorocarbon. The results indicate that: (1) arterial hypoxemia due to dependent pulmonary arteriovenous shunting caused by acceleration is not minimized by water immersion alone; (2) dogs can be respired with liquid fluorocarbon for four hours or longer, without clinical signs of respiratory distress; (3) liquid respiration prevented dependent pulmonary arteriovenous shunting at +6 Gy; (4) vertical gradients in pleural pressure gradients were approximately 0.7 cm H2O/cm vertical distance between pleural catheter tips in air breathing dogs in contrast to greater than 1.0 cm H2O/cm vertical distance in liquid breathing experiments; and (5) liquid breathing prevented inertial displacements of the heart and other mediastinal structures to dependent sites in the thorax, and roentgenographically evident pulmonary atelectasis in dependent regions. Author

N71-20359# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

AGE AND EXERCISE AS FACTORS INFLUENCING OSTEOPOROSIS, BONE STRENGTH, AND ACCELERATION TOLERANCE

L. E. Kazarian and H. E. Von Gierke *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 21 p refs (See N71-20351 09-04)
(AMRL-TR-70-74) Avail: NTIS

Spinal injury associated with escape from high performance aircraft has tended to occur more frequently in the aged than the younger aircrewman population. Although an age influence for this trauma has not been clearly demonstrated, it must be hypothesized. Osteoporosis is part of the normal aging process and accompanies most diseases affecting man. Disuse osteoporosis appears to be an exaggeration of the normal aging process. Mechanical stress, such as that produced by exercise and physical activity, is necessary for the retention of skeletal mass and may be a specific influence in controlling the adverse effects of osteoporosis. To produce a partial answer to the questions raised and their potential operational significance, 24 adult rhesus monkeys were subjected to 60 days of physical inactivity. The results show a decrease in spinal impact tolerance in terms of vertebral body fracture when experimentally produced osteoporotic primates were exposed to whole body longitudinal spinal impact. Histopathological examination at points of tendinous and ligamentous attachment show increased bone modeling activity. Author

N71-20360# Army Aeromedical Research Lab., Fort Rucker, Ala.

PROBLEMS OF ADAPTATION TO LONG RANGE LARGE SCALE AERIAL TROOP DEPLOYMENT

Stanley C. Knapp *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 14 p refs (See N71-20351 09-04)
Avail: NTIS

Stresses and adaptation problems demonstrated during large scale, long range, rapid reaction time, aerial troop deployments are described. NATO Exercise, REFORGER 1 and other recent large scale aerial troop deployments are discussed. Author

N71-20361# Texas Univ., Galveston. Dept. of Neurology and Psychiatry.

IMPULSIVENESS AND ANXIETY RELATED TO PERCEPTUAL MOTOR PERFORMANCE

Ernest S. Barratt and Gilbert Tolhurst (ONR, Arlington, Va.) *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 5 p refs (See N71-20351 09-04)
(Contract N00014-68-A-0105-0002)
Avail: NTIS

Anxiety and impulsiveness have been studied within a conceptual framework that recognizes four classes of variables: (1) everyday life experiences; (2) psychometric tests and psychometric interviews; (3) laboratory behavioral measures; and (4) psychophysiological measures. The overall goal was to describe anxiety and impulsiveness across all four classes of variables for both stress and nonstress conditions. Examples of the relationship of the interaction of impulsiveness and anxiety to perceptual motor performance are presented within the context of a brief discussion of the overall research program. Author

N71-20362# Aerospace Medical Research Lab., Wright-Patterson AFB, Ohio.

EFFECTS ON HUMAN PERFORMANCE OF COMBINED ENVIRONMENTAL STRESSES

Walter F. Grether *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 10 p refs (See N71-20351 09-04)
Avail: NTIS

Research studies of environmental effects normally expose subjects to only one stress at a time, while in operational flying there are usually several stresses acting simultaneously. The possibility exists that effects of such combined stresses may be greater than would be predicted from single stress studies. There have been relatively few laboratory studies of human performance in which the subjects have been exposed to such combined stresses. A critical review is presented of these past studies from the particular viewpoint of whether performance decrements from combined stresses are more severe than would be predicted from single stress studies. Although the number of past studies is not sufficient to present a consistent or conclusive picture, they do suggest that

combinations of environmental stresses do not present a special hazard in flying that could not be anticipated from results of single stress studies. Author

N71-20363# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).

THE NOVEL TASK AS A MEASURE OF PERFORMANCE UNDER ENVIRONMENTAL STRESS

M. F. Allnutt *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 4 p refs (See N71-20351 09-04)
Avail: NTIS

Experiments were conducted to determine human performance on a complex reasoning test under the stresses of temperature and altitude. In the analysis of the data special attention was given to those situations in which the subjects' first acquaintance with the task was under the stress condition. The experimental work along with a discussion of the advantages and disadvantages of using a novel task to assess performance under environmental stress is briefly discussed. Author

N71-20364# Centre d'Enseignement et de Recherches de Medecine Aeronautique, Paris (France). Lab. Central de Biologie Aeronautique.

IS LABORATORY EXPERIMENTATION USEFUL FOR STUDYING HUMAN ADAPTATION TO UNINHABITABLE SENSORY ENVIRONMENTS? [L'EXPERIMENTATION EN LABORATOIRE EST-ELLE PERTINENTE POUR ETUDIER L'ADAPTATION DE L'HOMME AUX ENVIRONMENT SENSORIELS INHABITUELS]

Roger Angiboust *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 7 p In FRENCH; ENGLISH summary (See N71-20351 09-04)
Avail: NTIS

Two experiments were conducted to study the adaptation of voluntary subjects to a degraded sensorial environment. These experiments showed that: (1) The behavioral and physiological response to an unusual environment depends on the subjects' level of education and personal interest in the test. (2) Adaptation to an unusual environment can be modified by giving to the tested subjects psychoaneleptics which induce behavioral manifestations of inadaptation in subjects who had been so far free from them. In light of these experiments, it appears that, for the subject, the significant stimulus is not the physical one or the arrangement of physical stimuli which excites his senses, but the meaning which he gives to the overall experiment situation, and the way he feels it. The importance of the decrement of physical stimuli does not affect the behavioral manifestations of inadaptation. The same physical environment can be felt as a neutral, indifferent stimulus, or, on the contrary, as an aggressive, nociceptive stimulus. Author

N71-20365# Italian Air Force Psycho-Phsiological Inst., Naples.

THE PSYCHOTHERAPEUTIC METHOD IN AVIATION PSYCHIATRY IN THE TREATMENT OF SOME SYNDROMES OF A REACTIVE CHARACTER

L. Longo *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 10 p refs (See N71-20351 09-04)
Avail: NTIS

The usefulness, in aviation psychiatry, of psychotherapeutic treatment of some syndromes of a reactive character, is shown through the description of 7 cases synthetically reported in their most indicative constitutive elements and in the psychodynamic modality of the relative psychotherapeutic treatment. Stress was laid on the advantages that accrue from the fact of being able to carry out the therapy in the environment itself, and on the favorable implications that can derive from it both on the strictly clinical plane and on the more specific one of maintaining and regaining flight fitness. Author

N71-20366# Italian Air Force Aerospace Medical Center, Rome (Italy).

EXPERIMENTAL RESEARCH ON HEAT BALANCE OF ATHLETES OF VARIOUS SPECIALTIES, DURING MUSCULAR EXERCISE IN DIFFERENT THERMAL ENVIRONMENTS

Paolo Rota and Antonio Todaro (Accident Prevent. Natl. Agency Res. Center) *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 8 p refs (See N71-20351 09-04)
Avail: NTIS

Athletes trained to different muscular exercises (long distance runners and sprinters) carried out work tests under conditions of thermal neutrality and in hot environments. During the tests, physiological parameters were recorded (central and skin temperatures, sweat loss, oxygen intake, work load, etc.), in order to calculate heat balance. Based on accumulated data, the behavior of thermal regulation, in respect to the different athletic specialties of the subjects tested, is discussed. Author

N71-20367# Army Medical Research and Nutrition Lab., Denver, Colo. Bioenergetics Div.

ENERGY METABOLISM DURING EXPOSURE TO EXTREME ENVIRONMENTS

C. F. Consolazio, H. L. Johnson, and H. J. Krywicki *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 11 p refs (See N71-20351 09-04)
Avail: NTIS

The energy requirements in a cold environment are practically unchanged as compared to a temperate environment, except for the 2 to 5% increase due to the wearing of the heavy clothes and footgear, providing that the individual is adequately clothed. However, the daily energy requirements for men living and working in a hot environment are increased. This is related to the increased requirement of the circulation in heat transport, the increased action of the sweat glands, increased caloric loss due to sweat vaporization and to the increase in body temperature. Balance studies including losses of nutrient in sweat indicate that these excretions are appreciable under conditions of profuse sweating. In the past, with the exception of sodium, very few investigators have recognized the fact that the mineral losses in sweat could be appreciable. The total mineral loss should include the mineral loss in sweat. This in turn would help in estimating more realistically the minimal daily allowances of minerals. Author

N71-20368# Army Medical Research and Nutrition Lab., Denver, Colo. Bioenergetics Div.

METABOLIC IMBALANCES AND BODY HYPOHYDRATION DURING FOOD DEPRIVATION (10 DAYS)

C. F. Consolazio, H. L. Johnson, and H. J. Krzywicki *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 8 p refs (See N71-20351 09-04)
Avail: NTIS

During studies of 6 men who fasted completely for 10 days, significant metabolic stresses developed which could eventually lead to serious abnormalities. These observations included great body hypohydration resulting in large body weight losses, large nitrogen and mineral losses, and a marked ketosis. These findings are not unusual since both the body fat and protein stores must be utilized as energy sources. The maintenance of normal blood carbohydrate levels require a known quantity of protein breakdown. As a result, it was suggested that low anti-ketogenic diets and adequate mineral supplementation could prevent the marked ketosis, minimize protein catabolism, maintain fluid balance, and decrease the electrolyte excretion. EKG's and EEG's were normal in both groups during the entire study. It appears that restricted diets containing less than 500 calories/day are inadequate for short term performance. Although they spared water, the protein catabolism was still a major problem. Author

N71-20370# School of Aerospace Medicine, Brooks AFB, Tex. Environmental Systems Div.

EFFECT OF ACUTE AND CHRONIC EXPOSURE TO 21 mm Hg AMBIENT P SUB CO2 ON EXERCISE RESPONSE OF NORMAL MAN

R. D. Sinclair, J. M. Clark, and B. E. Welch *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 9 p refs (See N71-21351 09-04)

Avail: NTIS

Physiologic responses to the interacting stresses of exercise and hypercapnia were studied in 4 young male subjects who were well trained and in excellent physical condition. The subjects performed light, intermediate and heavy exercise on a bicycle ergometer whil breathing air and during acute (15-30 minutes) and chronic (15-20 days) exposure to an ambient P sub CO2 of 21 mm Hg. Simultaneous measurements of V sub E, V sub O2, V sub CO2, pulse rate, rectal temperature, and arterial P sub O2, P sub CO2 and pH were made at rest and from the 12th-15th minute of steady state exercise in the supine P sub O2 position. Increases in V sub E, V sub O2 and V sub CO2 were linear in response to increasing work load for all experimental conditions, but the average magnitudes of these parameters at similar work loads were essentially equal in acute and chronic hypercapnia. At each work load average V sub E was higher and average V sub CO2 was lower in hypercapnia than the corresponding values in air. Average V sub O2 and pulse rate varied little for the same work load in the different experimental conditions. The differences between mean arterial P sub CO2 during acute and chronic hypercapnia and arterial P sub CO2 during air breathing increased progressively with increasing work load. Decreases in arterial pH from resting control values were also progressive with increasing work load, but were similar in magnitude for the three experimental conditions owing to differences in metabolic acidoses. Author

N71-20371*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

VOLITIONAL CONTROL OF VISUAL ACCOMMODATION

Robert J. Randle *In* AGARD Adaptation and Acclimatisation in Aerospace Med. Mar. 1971 13 p refs (See N71-20351 09-01)

(NASA-TM-X-66955) Avail: NTIS CSCL 06P

Research was conducted in an attempt to show that volitional control is possible in most individuals when feedback is provided which indicates to the subject his present accommodation level. The feedback was provided by modulating an audio-oscillator with the output of a servo-controlled infrared optometer which continuously monitored the refractive state of the subject's eye. Six young males with normal vision were trained to control their accommodation first using a tone and then without it. A specific task they learned was to accommodate toward 0 diopters when a 3-diopter checkerboard target was extinguished and they viewed a dark empty field. Their performance was compared against six untrained subjects on two dark empty field test tasks. The tasks were: (1) to maintain infinity focus while viewing a dark empty field for 3 minues; and (2) to go to infinity focus from a 3-diopter target when it was extinguished and a dark field ensued during a 3 minute period. A statistical analysis of the results showed that the trained group made significant reductions in their dark field myopia under these conditions, but the untrained subjects did not. Author

N71-20489*# Oak Ridge National Lab., Tenn. Neutron Physics Div.

THE ABSORBED DOSE AND DOSE EQUIVALENT FROM NEUTRONS IN THE ENERGY RANGE 60 TO 3000 MeV AND PROTONS IN THE ENERGY RANGE 400 TO 3000 MeV

R. G. Alsmiller, Jr., T. W. Armstrong, and W. A. Coleman (Army Nucl. Defense Lab.) 15 Jul. 1970 63 p refs Submitted for publication Supercedes N70-36818

(NASA Order H-38280A)

(NASA-CR-117314; ORNL-TM-2924-Rev) Avail: NTIS CSCL 20H

Nucleon-meson cascade calculations were carried out for monoenergetic neutrons (60 to 3000 MeV) and protons (400 to 3000 MeV) normally incident on a semi-infinite slab of tissue 30-cm thick, and the absorbed dose and dose equivalent as a function of depth in the tissue are presented. The calculated absorbed doses from 180- and 525-MeV incident neutrons and 660- and 730-MeV protons are compared with experimental data. For 525-MeV incident neutrons, the experimental and calculated absorbed doses are in good agreement, but this is not the case with the other comparisons. Author

N71-20493*# Techtran Corp., Glen Burnie, Md.

PROBLEMS OF SPACE BIOLOGY. VOLUME 11: THE TOXICOLOGY OF PRODUCTS OF VITAL ACTIVITY AND THEIR IMPORTANCE IN THE FORMATION OF ARTIFICIAL ATMOSPHERES OF HERMETICALLY SEALED CHAMBERS

V. V. Kustov et al Washington NASA Mar. 1971 158 p refs Transl. into ENGLISH of the publ. 'Problemy Kosmicheskoy Biologii, Tom 11: Toksikologiya Produktov Zhiznedeyatelnosti i Ikh Znacheniye v Formirovanii Iskusstvennoy Atmosfery Germetizirovannykh Pomeshcheniy' Moscow, Nauka Press, 1969 p 1-129

(Contract NASw-2037)

(NASA-TT-F-634) Avail: NTIS CSCL 06B

The formation of the gaseous products of vital activity is studied. Analyses of feces, urine, sweat, expired air and intestinal gases, the formation of harmful substances by the processes of decomposition of these products, and the effects of such products on experimental animals and humans are described. Formation of gaseous products of vital activity during normal metabolism is outlined. The specific problem of composition and hygienic significance of the gaseous substances accumulated beneath the clothing is discussed in detail. Chemicals to retard formation of harmful or nauseating gaseous products are discussed and their relative merits compared. Principles of establishing the permissible limits of concentration (PLC) of such products of vital activity as carbon dioxide, carbon monoxide, and hydrogen sulfide are contrasted with methods of establishing the PLC for industrial working environments. Author

N71-20546# California Univ., Davis. Radiobiology Lab.

[RADIOISOTOPE UPTAKE BY BEAGLE DOGS] Annual Report, 1970

Jun. 1970 121 p refs

(Contract AT(04-3)-472)

(UCD-472-117) Avail: NTIS

Collected abstracts contained in the annual report deal with radioactive isotope uptake in Beagle dogs and its effect on dog mortality, reproduction, morphology, and pathology. Radiation dosage rates and body burdens are emphasized. G.G.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N71-19399*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

INTEGRATED MANEUVERING LIFE SUPPORT SYSTEM Final Report, 31 May 1968 - 31 Oct. 1969

Douglas C. Howard Wright-Patterson AFB, Ohio AMRL Jul. 1970 12 p Prepared by Hamilton Std. Div., United Aircraft Corp., Winsor Locks, Conn.

(Contract F33615-67-C-1946)
(NASA-TM-X-66902; AD-714577; AMRL-TR-69-132) Avail: NTIS CSCL 06K

Successful completion of a design study of an extravehicular space suit assembly with an integrated life support system has led to the fabrication and evaluation of a human factors mockup. This mockup consists of a two-piece hard torso with soft arms and legs. A full bubble helmet and pressure gloves complete the pressure suit system. The hard torso is a volumetric representation of an integral life support system. It also contains an operational cold-gas propulsion system and controls and display panel. Sixteen thrusters provide accelerations of 0.3 ft/sec squared in three degrees of translation and 10 to 20 degrees of rotation. Author (GRA)

N71-19439* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPACE SUIT HEAT EXCHANGER Patent
Elton M. Tucker, inventor (to NASA) Issued 4 Feb. 1969 (Filed 27 Oct. 1967) 6 p Cl. 165-46; Int. Cl. F28f7/00; Int. Cl. A61f7/00; Int. Cl. F25d3/08
(NASA-Case-XMS-09571; US-Patent-3,425,487; US-Patent-Appl-SN-678700) Avail: US Patent Office CSCL 06K

A body heat exchanger for use with space suits is described which transfers thermal energy to or away from the body surface of the wearer. The heat exchanger is a very fine grid of small, flexible, high thermal conductance yarn in intimate contact with the body. Heat is transfered from the body surface into a liquid coolant loop, included as a portion of the assembly, which circulates a fluid of a desired temperature.
Official Gazette of the U.S. Patent Office

N71-19440* Solid State Radiations, Inc., Los Angeles, Calif.
BIOMEDICAL RADIATION DETECTING PROBE Patent
Fred P. Burns and Josef E. Friederichs, inventors (to NASA) Issued 11 Feb. 1969 (Filed 23 Dec. 1965) 7 p Cl. 250-83; Int. Cl. G01t1/02 Sponsored by NASA
(NASA-Case-XMS-01177; US-Patent-3,427,454; US-Patent-Appl-SN-516150) Avail: US Patent Office CSCL 06B

A biomedical nuclear radiation detecting probe for in vivo use is described. The p-type semiconductor diode fabricated from high resistivity silicon crystal is bullet shaped, and the junction is formed by diffusion of phosphorus over the nose end of the crystal. A silver casing is sleeved over the crystal with only the diffused nose of the crystal protruding. A miniature hermetically sealed coaxial cable extends through the back of the casing. The ground lead connects with the casing which is coupled to the n-type phosphorus. The bore of the casing adjacent to the electrical connection to the p-type region of the crystal is filled with a non-oxidizing gas. A reverse voltage bias is applied to the p-n junction whereby penetrating radiation gives rise to voltage pulses which are conducted by the cable to a recording apparatus.
Official Gazette of the U.S. Patent Office

N71-19579# Army Medical Research Lab., Fort Knox, Ky.
WORD READING, COLOR NAMING AND STROOP INTERFERENCE AS A FUNCTION OF BACKGROUND LUMINANCE
Frederick N. Dyer 20 Aug. Aug. 1970 22 p refs
(AD-716351; USAMRL-889) Avail: NTIS CSCL 17/8

Response times were recorded for six Ss while naming colors in conditions with and without interference to color naming and also while reading words. Processing rates of word and color information were manipulated by varying the background luminance of the color stimuli. Interference to color naming from incongruent color words was ascertained when word reading was fast relative to color naming and when the reverse was true. The relevance of this paradigm for the study of information processing is discussed.
Author (GRA)

N71-19604# Army Medical Research Lab., Fort Knox, Ky.
EVALUATION OF GUNDEFENDER EARPLUG: TEMPORARY THRESHOLD SHIFT REDUCTION AND SPEECH INTELLIGIBILITY
James D. Mosko and John L. Fletcher 9 Oct. 1970 13 p refs
(AD-716356; USAMRL-903) Avail: NTIS CSCL 6/17

Prototypes of the Sonex Gundefender earplug were evaluated with reference to the ear protection capabilities of the earplug and the speech intelligibility scores obtained in both noise and quiet conditions. The medical standard V.51R earplug was used as a comparison unit. A temporary threshold shift reduction method was used for the comparison of protective capabilities. Magnetic recordings of the Modified Rhyme Test were used to obtain the speech intelligibility data.
Author (GRA)

N71-19605# Washington Univ., Seattle. Dept. of Psychology.
LEARNING AND OPTIMIZATION OF COGNITIVE CAPABILITIES Final Report
A. A. Lumsdaine, Earl Hunt, Lee R. Beach, R. R. Dagano, and H. H. Wells Jun. 1970 9 p refs
(Grant AF-AFOSR-1701-69)
(AD-716459; AFOSR-70-2761-TR) Avail: NTIS CSCL 5/10

The report summarizes briefly the work of a three-year series of experimental studies of human cognition, involving the investigation of problem solving and learning in man-machine interaction situations, and of variables and processes relevant in such situations. The work included four separate projects: Computer-aided problem solving, computer-aided instruction techniques, feedback in concept learning, and intuitive decision making. Each of the four projects was concerned with research to obtain knowledge that could contribute to the efficiency of man-machine systems functioning in making decisions and performance of various related kinds of intellectual tasks.
Author (GRA)

N71-19674# Human Resources Research Organization, Alexandria, Va.
A PROTOTYPE PICTORIAL PROGRAM FOR A GROUND SURVEILLANCE RADAR SET OPERATOR
Joseph P. Militello and Gary G. Boycan Dec. 1969 37 p
(Contract DAHC19-79-C-0012)
(AD-716246) Avail: NTIS CSCL 5/9

The document was prepared as preliminary material for training personnel in the SEA NITEOPS Program, and as a basis for the later development of resident training programs. However, subsequent to the development of this pictorial training program, it was decided that the device would not be obtained for operational use. The pictorial program is made available as an illustration of a type of training guide, which might be useful either as an operator performance aid or as a classroom training aid.
Author (GRA)

N71-19710# Human Engineering Labs., Aberdeen Proving Ground, Md.
THE EFFECT OF COCKPIT LIGHTING SYSTEMS ON MULTICOLORED DISPLAYS
John A. Barnes Dec. 1970 34 p refs
(AD-716610; HEL-TM-30-70) Avail: NTIS CSCL 1/4

The report analyzes the performance of 42 subjects reading aircraft instruments comprising various combinations of pointer/background colors viewed with both Army/Navy IPL Red and Air Force Blue-White cockpit lighting systems. The results rank the pointer/background color combinations according to the least number of scale-reading errors they produced.
Author (GRA)

N71-19751# National Aerospace Lab., Tokyo (Japan).
A SIMULATOR EXPERIMENT TO INVESTIGATE HUMAN BEHAVIOR IN TRACKING TASKS
Goro Beppu, Tosiho Sakai, and Junichi Yoshida Aug. 1970 18 p

refs In JAPANESE; ENGLISH summary
(NAL-TR-208) Avail: NTIS

The way in which human behavior in roll tracking tasks is adapted to the variation of controlled element characteristics was investigated in flight simulator experiments. The investigations were carried out by calculating the describing function of the human being Y sub p (j omega) and the open-loop describing function Y sub p Y sub c (j omega). As L sub p is large, the time constant of lead equalization in Y sub p is small. When L sub delta a is large, the time lag of human behavior is small. This means that a human being controls an airplane with large average muscle tension. When L sub delta a is too large, K sub p L sub delta a is not constant. This is due to the fact that the change in L sub delta a is too large to be compensated by K sub p. Author

N71-19772# General Electric Co., Schenectady, N.Y. Research and Development Center.

DEVELOPMENT OF A PERSELECTIVE MEMBRANE SYSTEM FOR CONTINUOUS CARBON DIOXIDE CONTROL Final Report, Jan. 1968 – Apr. 1970

Charles K. Neulander and Frederick J. Martin Wright-Patterson AFB, Ohio AMRL Oct. 1970 34 p refs
(Contract F33615-68-C-1234)
(AD-715978; S-70-1088; AMRL-TR-70-44) Avail: NTIS CSCL 6/11

An immobilized liquid film of an aqueous bicarbonate/carbonate solution, and including a catalyst for the hydrolysis of CO2, has been incorporated into a system for removal of CO2 from a life-supporting environment in space. A method of packaging the membrane is described. A one-man system, requiring 18.3 square yards of membrane, was constructed and tested. Approximately the same membrane area is required for both spacecraft cabin control and for astronaut extra-vehicular back-pack application. Permeation results are given for a variety of conditions. Virtually no oxygen is lost through the membrane, and the anticipated system has the advantage of not requiring regeneration or replacement of any components. Author (GRA)

N71-19776*# Quantum Dynamics, Tarzana, Calif.

SOME RECENT ADVANCES IN THE TECHNOLOGY OF HIGH RESOLUTION DYNAMIC AND CONTINUOUS RESPIRATORY AND METABOLIC MEASUREMENTS ON BREATH-BY-BREATH AND TM BASIS Final Report

Aug. 1970 136 p refs
(Contract NAS9-8185)
(NASA-CR-114905) Avail: NTIS CSCL 06B

Assigned tasks of supplying advanced bidirectional respiratory flowmeters and electronic instrumentation systems for the measurement, analysis, and computation of metabolic quantities are discussed. The main purpose is to: (1) review and analyze technological advances in respiratory and metabolic instrumentation, (2) discuss administrative, technical, and other problems encountered during the performance of the contract, and (3) propose future effort. Author

N71-19785*# Fairchild Hiller Corp., Farmingdale, N.Y. Manned Space Systems.

SPACE STATION/BASE FOOD SYSTEM STUDY Contract Summary Report

31 Dec. 1970 14 p
(Contract NAS9-11139)
(NASA-CR-114886; DRL-7) Avail: NTIS CSCL 06K

Detailed performance characteristics, functional descriptions, sketches, and parametric data are given for developing realistic mission models of food systems that will sustain a spacecrew for extended periods of time. The requirements established to meet these needs include: variety of food; capability to store, prepare, and serve; facilities to store required consumables and expendables; logistics and inventory control; and capability to clean equipment and dispose of resulting debris. E.M.C.

N71-19798# Rowland and Co., Haddon Field, N.H.

IN SUPPORT OF ADVANCED DEVELOPMENT OBJECTIVE 43-13, HUMAN FACTORS TECHNOLOGY Annual Report, 1 Dec. 1969 – 30 Nov. 1970

Edward Marlowe, Carlos Escobar, and George E. Rowland 30 Nov. 1970 159 p refs
(Contract N00014-70-C-0126)
(AD-716473; R/C-70-11-105; AR-1) Avail: NTIS CSCL 5/9

The report describes the approach used and the progress made in the application of existing knowledge and technology to the test of computerized techniques which incorporate adaptive training conceptsand improved techniques for the prediction of Naval flight student training success. Because these computerized techniques require a unique combination of special data inputs, data file organization, and specific computer software routines to process the file data, this combination is called a data management system. The system will consist of a newly defined data bank and file organization of student pilot selection, performance and administrative data; computerized techniques for processing these data are developed to support a series of fourteen system modules. When implemented the data management system is expected to provide improved procedures for the handling of student pilot training. These improved procedures can be expected to result in reduced attrition in the flight syllabus, more effective placement of students in the pipelines, in possible changes in the flight syllabus content, flight hours, and syllabus duration for certain students. Author (GRA)

N71-19818# Boeing Co., Seattle, Wash. Military Aircraft Systems Div.

COCKPIT GEOMETRY EVALUATION, PHASE 2. VOLUME 2: HUMAN DATA Final Report, 1 Jan. – 31 Dec. 1969

Patrick W. Ryan, Wayne E. Springer, and Michael P. Hiastala Feb. 1970 311 p refs
(Contract N00014-68-C-0289)
(AD-716296; D162-10126-2-Vol-2; JANAIR-700202-Vol-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 1/3

The Cockpit Geometry Evaluation Program is a collection of techniques for improved methods of evaluating the interaction and compatibility of crew members with crew stations. The primary tool for accomplishing the evaluation is a 23 joint, three dimensional man-model (BOEMAN-II) that through mathematical techniques simulated human motion. This Phase II volume is an updating of the Phase I Human Data Document (D162-10126-1). The updating includes a description of the three dimensional body segments which are placed around the link system of BOEMAN-I and a summary of available literature concerning limit, mass, and visual characteristics used in developing the man-model are also listed in this document. Author (GRA)

N71-19819# Boeing Co., Seattle, Wash. Military Aircraft Systems Div.

COCKPIT GEOMETRY EVALUATION, 2. VOLUME 3: COMPUTER PROGRAM Final Report, 1 Jan. – 31 Dec. 1969

Robert Katz, Ann Rice, and Elsie I. Nakagawa 31 Jan. 1970 437 p refs
(Contract N00014-68-C-0289)
(AD-716397; D162-10127-2-Vol-3; JANAIR-700203-Vol-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 1/3

The Cockpit Geometry Evaluation Program is a development of improved methods for evaluating the physical compatibility of crew members with crew stations. The heart of the program is a 23 joint, three dimensional man-model (BOEMAN-II) that simulates the motion of humans performing tasks in a given environment. The Computer Program System ties together all developments of the project. The System utilizes an updatable bank of anthropological and environmental data. The System provides information concerning reach capability, locations and orientation of joints and body segments during movement, and/or physical interference of

BOEMAN-II with the crew station and with himself, numerical performance data on joint displacement and deflection and mass displacements. Author (GRA)

N71-19820# Boeing Co., Seattle, Wash. Military Aircraft Systems Div.

COCKPIT GEOMETRY EVALUATION, PHASE 2. VOLUME 4: MATHEMATICAL MODEL Final Report, 1 Jan. 1969–31 Jan. 1970

Michael J. Healy Jan. 1970 82 p refs

(Contract N00014-68-C-0289)

(AD-716398; D162-10128-2-Vol-4; JANAIR-700204-Vol-4) Avail: NTIS CSCL 1/3

The Cockpit Geometry Evaluation (CGE) Program is developing a computerized method to evaluate the physical compatibility of crew members with crew stations beginning with the conceptual phases of the design. The method uses a mathematical link-system model of a human crew member to represent any specified member of a human population. Three approaches to the problem of simulating human motion on the computer are examined. The two most important approaches require the development of algorithms to specify values for link-system orientation parameters. Since a baseline model was required for Phase I of the CGE Program, a general mathematical technique based on nonlinear optimization was selected to solve for link-system parameters. The optimization model was refined during Phase II and validated against selected human subject motions. Author (GRA)

N71-19821# Boeing Co., Seattle, Washington. Military Aircraft Systems Div.

COCKPIT GEOMETRY EVALUATION, PHASE 2. VOLUME 5: VALIDATION Final Report, 1 Feb. 1969–31 Jan. 1970

Harland N. Sather and Arthur W. Bearse Feb. 1970 139 p refs

(Contract N00014-68-C-0289)

(AD-716399; D162-10129-Vol-5; JANAIR-700205-Vol-5) Avail: NTIS CSCL 1/3

The Cockpit Geometry Evaluation Program is a collection of techniques for improved methods of evaluating the interaction and compatibility of crew members with crew stations. The primary tool for accomplishing the evaluation is a 23 joint, three-dimensional man-model (BOEMAN-II) that mathematically simulates human motion. The validation criteria and methods for judging the performance of the man-model are discussed in this volume. A combination of statistical, numerical, and graphical analyses were used to rate the model. Included are discussions of the experimental procedures used to generate human motion and the subsequent mathematical comparative techniques. Author (GRA)

N71-19911# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.

PLACEMENT OF AIRCRAFT CONTROLS

John W. Garrett, Milton Alexander, and Chester W. Matthews Sep. 1970 459 p refs

(AD-715975; AMRL-TR-70-33) Avail: NTIS CSCL 1/3

Data are presented to guide the designer in placing aircraft controls to be operated by lightly clothed or pressure-suited aircrewmen. The capabilities of 17 subjects wearing various combinations of personal equipment to reach 81 locations within a 180 deg arc forward of seat reference point were determined. Each subject was tested while wearing personal equipment, consisting of an underarm life preserver, parachute harness and, successively, a K2B flight coverall, an uniflated, and inflated A/P22S-2 full-pressure suit. The subjects sat in a seat configured to approximate Air Force specifications. During the test they were restrained in the seat by a lap belt and shoulder straps with the inertial reel locked and again with the inertial reel unlocked. Pictorial descriptions of the dimensions, the reach capabilities of each subject, and recommended design values are presented. Author (GRA)

N71-20008*# Space/Defense Corp., Birmingham, Mich. Basic and Applied Research Staff.

[RESPIROMETER DEVELOPMENT PROGRAM AND GRAVITY AND NEUROHYPOPHYSEAL SECRETORY ACTIVITY] Final Technical Report

8 Jan. 1971 35 p refs

(Contract NASw-870)

(NASA-CR-117179; TR71-102) Avail: NTIS CSCL 06B

The design, development, and testing of microrespirometers are described. Single specimen respirometer prototypes were developed to measure oxygen consumption of a sprouting potato plug for 90 days, compatible with a life support system on an unmanned spacecraft such as the Pioneer. A multispecimen respirometer was also designed to measure a biostatistically significant sample. It is felt that the microrespirometers are space flight-qualified with respect to sensitivity and accuracy as functions of size, weight, volume, and power. Initial research studies on the hypothalamo-hypophyseal system of fresh water teleosts under a variety of modes in a one-g environment are also described. The major efforts were on design of an environmental control system, development of surgical procedures for bilaterally eliminating the utriculi in fish, and inducing voluntary reorientation relative to the earth's gravitational field with altered light cues. Bioassay and immunology programs are discussed. N.E.N.

N71-20239*# Hayes International Corp., Huntsville, Ala. Missile and Space Support Div.

DEVELOPMENT OF AN OPEN CIRCUIT CRYOGENIC LIFE SUPPORT SYSTEM FOR USE IN NEUTRAL BUOYANCY SPACE SIMULATION

C. M. McClure and C. W. Williams *In* NBS Space Simulation Oct. 1971 p 623–649 Sponsored by NASA (See N71-20201 09-11)

(NASA-CR-117143) Avail: NTIS; SOD $5.25 CSCL 06K

A self contained underwater life support system which can supply a breathing mixture to the neutral buoyancy test subject, without a surface tethered supply line is discussed. A prototype system has been developed which utilizes a mixture of liquid oxygen and liquid nitrogen contained in a single supply tank. Development and testing have shown that this system will supply the quantity and quality of gas required under completely controlled and predictable condtions to depths of at least 60 feet. Author

N71-20268* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

G CONDITIONING SUIT Patent

Clinton Eugene Brown and Ralph W. Stone, Jr., inventors (to NASA) Issued 19 Aug. 1969 (Filed 2 Feb. 1965) 8 p Cl. 128-1; Int. Cl. A61b19/00

(NASA-Case-XLA-02898; US-Patent-3,461,855; US-Patent-Appl-SN-429932) Avail: US Patent Office CSCL 06B

A G conditioning suit is described which is operative on the cardiovascular system of a body to make it function as it normally does in a gravity environment. The suit structure and associated apparatus is designed such that a decreasing pressure is applied from the area of the head to the feet thus controlling the flow of blood in a body to accomplish the result gravity has on the cardiovascular system. Detailed descriptions accompany drawings of the device. Official Gazette of the U.S. Patent Office

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N71-19351 California Univ., Los Angeles.
VACUUM ULTRAVIOLET AND PHOTOIONIZATION STUDIES ON OLEFINS
Daniel Amadeo Demeo (Ph.D. Thesis) 1969 244 p
Avail: Univ. Microfilms: HC $11.05/Microfilms $3.15 Order No. 70-2196

Vacuum ultraviolet absorption and photoionization studies are reported which have been carried out on a number of alkyl-substituted, endocyclic, exocyclic and bicyclic olefins. Vacuum ultraviolet absorption spectra show a transition in the 55-60,000/cm region, due to the excitation of one of the pi-electrons of the double bond to an antibonding pi*-orbital. The frequency of this transition shifts to lower energy with increasing substitution at the double bond. In the special case of 1,1-disubstitution, the shift to longer wavelength is more pronounced. There is little or no ring effect on these pi yields pi* transitions of either cyclic or exocyclic olefins, only the normal effect of the attached substituents. However, in the case of conjugation, the pi-orbitals are split and the absorption spectra correspondingly altered. Also, in the case of bicyclic compounds, in which the geometry of the molecule imposes interaction on the pi-orbitals, the spectra are greatly altered, due to breakdown of sigma-pi separability. Dissert. Abstr.

N71-19396# National Lead Co. of Ohio, Cincinnati.
SIMULTANEOUS DETERMINATION OF 22 IMPURITY ELEMENTS IN THORIUM MATERIALS USING A PRODUCTION CONTROL QUANTOMETER
G. R. Blank and J. R. Reusch Oct. 1970 30 p refs Presented at the 14th Ann. Conf. on Anal. Chem. in Nucl. Tech., Gatlinburg, Tenn., 13-15 Oct. 1970
(Contract AT(30-1)-1156)
(NLCO-1078; CONF-701017-1) Avail: NTIS

A rapid, direct-reading emission spectrometric method is described for determination of 22 impurities in ThO2 using a 2-meter production control quantometer. The ThO2 samples are mixed with 6% AgCl-LiF(11:1 carrier), and 100-mg charges are excited in a dc arc of 14 amperes. Use of a programmed series of preintegration and total-integration timers minimizes spectral background effects and permits optimum integration of the spectral response for each element regardless of its volatilization rate. The method permits the simultaneous determination of the following elements: Al, B, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, Pb, Si, Sn, V, Zn, and Zr. The lower reporting limits are 0.1 ppM for B and Cd; 5.0 ppM for Fe, Si, Zn, and Zr; and 1.0 ppM for all other elements determined. Precisions range from 10 to 30% relative at the 95% confidence level. Compared with spectrographic methods previously used, the direct-reading method eliminates costs of photographic plates, reduces elapsed time for analysis. Author (NSA)

N71-19398# Bureau of Radiological Health, Rockville, Md. Div. of Medical Radiation Exposure.
THE USE OF RADIOACTIVE MATERIALS IN GAS CHROMATOGRAPHY
George L. Pettigrew and Jerome A. Halperin Oct. 1970 19 p refs
(PB-195970; BRH/DMRE-70-5) Avail: NTIS CSCL 07D

The following topics are presented: operating principles of gas chromatography, the hazards from radioactive materials used in chromatographs, and safety precautions which could minimize the hazards. Safety factors are emphasized in conjunction with radiation sources. Author (GRA)

N71-19424# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information Extension.
TRANSPLUTONIUM ELEMENTS: A BIBLIOGRAPHY
Charles E. Stuber Oct. 1970 92 p refs
(TID-3317-SUPPL-2) Avail: NTIS

This bibliography is the second supplement to the original TID-3317 and contains 557 citations and abstracts of the international literature dealing with the production, chemical, physical, and nuclear properties, and natural occurrence of the transplutonium elements. References are grouped by element and arranged chronologically within each group. A transactinide group is includes for references dealing with elements Z > or = 104. A detailed subject index and an author index with titles are also included. NSA

N71-19543# Avco-Everett Research Lab., Everett, Mass.
METAL OXIDE CHEMISTRY AND INFRARED BAND INTENSITIES Final Report, 15 Dec. 1969-14 Aug. 1970
C. W. Von Rosenberg, Jr. and Kurt L. Wray Oct. 1970 69 p refs
(Contract F19628-70-C-0144)
(AD-716493; AFCRL-70-0597) Avail: NTIS CSCL 7/4

Shock tube experiments to measure the Fe + O2 gas phase reaction rate and the FeO fundamental band intensity, by using iron penetacarbonyl as a source of iron atoms, are described. A lower bound for the reaction Fe + O2 kl to FEO + O of K(1) = 3 X 10 to the 12th cu cm/(mole sec) for T > or + 2400K and an integrated fundamental FeO band intensity of 450/ama sq cm are reported. In addition the rate of vibrational relaxation of CO by Fe-atoms for T = 1400-1900K is given. Calculations for similar experiments on Al + O2 by the use of trimethylaluminum as a source of aluminum atoms are presented. Author (GRA)

N71-19562*# Colorado State Univ., Fort Collins. Dept. of Chemistry.
ELECTROCHEMICAL STUDIES IN ALUMINUM CHLORIDE MELTS Semiannual Status Report, 15 Aug. 1970-14 Feb. 1971
R. A. Osteryoung 1971 128 p refs
(Grant NGR-06-002-088)
(NASA-CR-117056) Avail: NTIS CSCL 07D

CONTENTS:
1. ALUMINUM CHLORIDE CONTAINING SOLVENT SYSTEMS AS ORGANIC REACTIONS MEDIA: A LITERATURE SURVEY p 2-46 refs (See N71-19563 09-06)
2. ACID BASE EQUILIBRIUM IN NaAlCl4 MELTS AND EXPERIMENTAL WORK p 47-73 (See N71-19564 09-06)
3. SYSTEM FOR COMPUTERIZATION OF ELECTROCHEMICAL MEASUREMENTS IN FUSED SALTS, APPENDIX 1 p 74-80 (See N71-19565 09-06)
4. THE i(SQ. ROOT OF t) COMPUTER PROGRAM, APPENDIX 2 p 81-96 refs (See N71-19566 09-08)

N71-19563*# Colorado State Univ., Fort Collins. Dept. of Chemistry.
ALUMINUM CHLORIDE CONTAINING SOLVENT SYSTEMS AS ORGANIC REACTIONS MEDIA: A LITERATURE SURVEY
In its Electrochem. Studies in Aluminum Chloride Melts 1971 p 2-46 refs (See N71-19562 09-06)
Avail: NTIS CSCL 07D

The solvent systems offer the advantages of short reaction times, ease of product recovery, and saving on solvent costs. Numerous organic reactions are found to take place in these AlCl3 solvent systems, the largest catagories being condensation-addition, rearrangement-isomerization, and dehydrogenation-addition reactions. Dehydration, exchange, and reduction-chlorination reactions were also found to occur. The AlCl3 solvent systems where one of the components is an organic compound, e.g., the AlCl3-pyridine system, were used as media for organic reactions. A limited number of mechanistic studies were carried out. Only two reports appeared on the electrochemical behavior of organic compounds in AlCl3 solvent systems. One of these involved a preliminary study

on the electro-oxidation of several polynuclear hydrocarbons while the other involved electro-initiated polymerization of aromatic hydrocarbons. Author

N71-19564*# Colorado State Univ., Fort Collins. Dept. of Chemistry.
ACID BASE EQUILIBRIUM IN NaAlCl4 MELTS AND EXPERIMENTAL WORK
In its Electrochem. Studies in Aluminum Chloride Melts 1971 p 47–73 (See N71-19562 08-06)
Avail: NTIS CSCL 07D

A simple versatile experimental cell for the NaAlCl4 melts was designed. An unknown solid with an apparent equimolar NaCl–AlCl3 composition was found to form in the NaAlCl4 melts at temperatures below 225 C. Carbon, platinum, and tungsten electrodes were used as indicator electrodes. Hydrogen chloride gas was bubbled through the NaAlCl4 melt and a reduction potential of 1.15 volts vs aluminum for H(+) was observed. The reduction potential of H(+) is a direct function of the Cl(−) concentration in the melt in a similar fashion to that observed for the aluminum electrode. Iron was added to the system by anodizing iron wire and by adding anhydrous ferric chloride. Cyclic voltammetry, pulse polarography, chronoamperommetry, and chronopotentiometry were used to study the Fe(+3)/Fe(+2) couple, the reduction potential of Fe(+2), and the diffusion coefficient for Fe(+3). The results indicate Fe(+2) is moderately adsorbed at 0.64 volts and only weakly adsorbed at 1.53 volts. The electro-oxidation of ferrocene in a NaAlCl4 melt was investigated. It appears that ferrocene undergoes a reversible one-electron oxidation with possible product adsorption. Author

N71-19565*# Colorado State Univ., Fort Collins. Dept. of Chemistry.
SYSTEM FOR COMPUTERIZATION OF ELECTROCHEMICAL MEASUREMENTS IN FUSED SALTS. APPENDIX 1
In its Electrochem. Studies in Aluminum Chloride Melts 1971 p 74–80 (See N71-19562 08-06)
Avail: NTIS CSCL 07D

The current state of the development of a system for the computerization of electrochemical measurements in fused salts is discussed. Several improvements were made to existing programs and electronic interfacing. A chronoamperometric program which automatically compensates for background was developed to measure electrode areas and for diffusion coefficients. The plan for a pulse polarography program utilizing a dropping mercury electrode is included. Author

N71-19631# Royal Aircraft Establishment, Farnborough (England).
POSSIBLE FUTURE DEVELOPMENTS IN THE SYNTHESIS OF AROMATIC POLYIMIDES [PERSPEKTIVY RAZVITIYASINTEZA AROMATICHESKIKH POLIIMIDOV]
M. M. Koton Oct. 1970 21 p refs Transl. into ENGLISH from Khim. Volokna (USSR), v. 4, 1969 p 15–22
(RAE-Lib-Trans-1499; BR22676) Avail: NTIS

Past and current developments in the synthesis of aromatic polyimides and the related amide-imides, ester-imides and pyrrones are summarized. Some data are given on mechanical properties, and thermal stability. Author

N71-19721# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
BASIC STUDIES OF LIQUID CRYSTALS AS RELATED TO ELECTROOPTICAL AND OTHER DEVICES Final Technical Report, 1 Jun. 1967–30 May 1970
L. C. Scala, G. D. Dixon, and D. F. Ciliberti 27 Aug. 1970 69 p refs
(Contract F44620-67-C-0102; ARPA Order 1003)
(AD-716003; AFOSR-70-2520TR) Avail: NTIS CSCL 7/4

The usefulness of optical devices, whose sensors consist of cholesteric liquid crystal combinations, is directly dependent upon the reproducibility of their color responses to changes in temperature and to electric fields. Many of the processes by which cholesteric liquid crystals lose their valuable optical properties were identified and steps taken to diminish or eliminate their effects. Oleyl cholesteryl carbonate, one of the essential components of field- and heat-sensitive liquid crystal mixtures, was found to decompose spontaneously to give CO and CO2 at a relatively small rate, which may still be too large in the case of applications involving sealed, evacuated systems. The thermal hysteresis observed in high temperature-sensitive liquid crystals was mainly dependent upon the material composition of the system and on the operating range. On shearing, cholesteric liquid crystal layers lost color intensity, but the wavelength of their maximum reflectance did not change appreciably. The rate of intensity recovery after cessation of shearing was linear with the logarithm of time. The main degradative process is brought about by the combined and cumulative influences of ultraviolet light, oxygen and air-borne particulates; as a result, the color-bearing cholesteric structure is changed into a non-colored texture and the color responses are lost. This drawback was remedied by incorporating ultraviolet energy absorbers and polymeric protectants into the liquid crystal combinations. With these modified systems the useful life of cholesteric liquid crystal sensing systems was prolonged by several months. Author (GRA)

N71-19869# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
THE THERMODYNAMIC PROPERTIES OF COMPRESSED GASEOUS AND LIQUID FLUORINE
Rolf Prydz and Gerald C. Straty Oct. 1970 199 p refs
(AD-716286; NBS-TN-392) Avail: SOD $1.50; NTIS CSCL 7/4

An apparatus has been constructed and used successfully to measure vapor pressure and PVT data of fluorine from the triple point to 300 K at pressures to about 24 MN/sq m. Material problems caused by the toxic and corrosive nature of fluorine were solved. A network of isotherm and isochore polynomials and a truncated virial equation were used to represent all PVT data. These equations represent the data with an average standard deviation of about 0.02 percent in density, the corresponding accuracy being estimated at 0.1 percent. Equations for the saturated liquid and vapor densities, the vapor pressure curve, the melting line, and the ideal gas properties are also presented. Comparisons are given to published values of the second virial coefficients, vapor pressures, and saturation densities. Additional comparisons are also made to measured specific heats and latent heats of vaporization. New values are reported for the triple point and critical point parameters together with the temperature and saturation densities at the normal boiling point. Finally, extensive tables of thermodynamic properties of fluorine are given which include pressure, temperature, density, isotherm and isochore derivatives, internal energy, enthalpy, entropy, specific heats at constant pressure and volume and velocity of sound. Author (GRA)

N71-19914*# Hamilton Standard, Windsor Locks, Conn.
LITHIUM PEROXIDE TEST PROGRAM Final Report
L. A. Willis Dec. 1970 178 p refs
(Contract NAS9-9159)
(NASA-CR-114896; SUHSER-5712) Avail: NTIS CSCL 07D

Test results defining the operating characteristics of lithium peroxide to the extent required to quantify system level penalties are reported. The effects of chemical catalysts, bed cooling, chemical manufacturing techniques, operating conditions, and chemical handling procedures are evaluated. Author

N71-19933# Rice Univ., Houston, Tex.
STUDIES IN THE PHYSICAL CHEMISTRY OF SELECTED HIGH TEMPERATURE SYSTEMS Progress Report, 1 Dec. 1969–30 Nov. 1970

John L. Margrave and Philip R. Brooks 30 Nov. 1970 8 p refs
(Contract AT(40-1)-2907)
(ORO-2907-73) Avail: NTIS

Continuing research reported includes the following: (1) Mass spectrometric monitoring was used to identify vapor species and to provide ionization potentials and appearance potentials for several different systems. (2) The evolution of hydrocarbons and related species from heated tektites and meteorites was quantitatively studied. (3) A compact, economical and efficient apparatus was constructed and used for studies of molecules isolated at low temperatures in matrices of Ne, Ar, Kr, Xe, N2, Co, etc. (4) High pressure bomb calorimetry was used to establish high precision thermodynamic properties of both 02 and F2 oxidations. (5) various liquid metals were studied by the application of levitation calorimetry. (6) An investigation was conducted of the steric hindrance by reacting oriented molecules in crossed molecular beams. D.L.G.

N71-20090*# Translation Consultants, Ltd., Arlington, Va.
TRANSPORT PROPERTIES OF CHEMICALLY REACTING GASES [SVOYSTVA PERENOSA KHIMICHESKY REAGIRUYUSHCHIKH GASOV]
Ye. V. Samuylov et al Washington NASA Mar. 1971 12 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur, Akad. Nauk SSSR (Moscow), v. 8, no. 4, Jul.–Aug. 1970 p 754–761
(Contract NASw-2038)
(NASA-TT-F-13486) Avail: NTIS CSCL 07D

The effective interaction cross sections for different pairs of the following components: CO2, CO, H2, O2, N2, H2O, NO, OH, O, N, H, and HCO are determined. To simplify computer calculations, the collision integrals are represented in the form of simple approximating functions of temperature. The parameters of the collision integrals were determined under the assumption that the interaction of atoms and molecules in excited electronic states remains the same as that for the fundamental states. At temperatures up to 1500 K, the interaction energies were determined from measurements of viscosity and diffusion coefficients; above 3000 K, the interaction energies were determined from data for molecular beam scattering and from measurements of the vibrational relaxation time. Author

N71-20098# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
ELECTROADSORPTION IN PULSE POLAROGRAPHY. APPLICATION TO THE STUDY OF SOME RARE EARTH ELEMENTS [L'ELECTROADOSORPTION EN POLAROGRAPHIE A IMPLUSIONES. APPLICATION A L'ETUDE D'UNE SERIE DE TERRES RARES]
Yves Chapron Nov. 1970 132 p refs In FRENCH
(CEA-R-4040) Avail: AEC Depository Libraries

A theoretical treatment of electrode reactions allowed expressions to be derived for the Faraday current. After briefly reviewing various known isotherms, it is shown how these may be used to derive an expression for the current in the case where the electrode kinetics are governed by the adsorption step. The kinetic expressions for electrode coverage are calculated along with the equations for the served pulse polarograms. The adsorption properties of organometallic complexes in pulse polarography were applied to a study of a series of rare earth elements. The gradients of the i sub p equals f(c) plots for the various rare earths can be classified according to the atomic number of the elements. This effect was interpreted using the electronic structure of the lanthanides. It can be noted that the i sub p equals f(c) relationships can be used to analyze a mixture of two known rare earths. Furthermore, it was possible to carry out rapid electrochemical kinetics measurements using integral pulse polarography. Author (NSA)

N71-20152*# Stanford Research Inst., Menlo Park, Calif. Physical Sciences Div.
STUDY OF THE SYNTHESIS OF BLOCK COPOLYMERS Final Report, 18 Oct. 1966–18 Aug. 1970
J. Heller Sep. 1970 94 p refs Prepared for JPL
(Contract NAS7-523; SRI Proj. PRU-6297)
(NASA-CR-117305) Avail: NTIS CSCL 07C

The synthesis of 4-vinylbiphenyl-isoprene ABA block copolymers is discussed as well as a detailed characterization of these materials, and attempts to influence permeation rates by changes in morphology. The synthesis of ABA block copolymers containing no C-H bonds is also included. In addition to providing a model for permeation studies, the block copolymers synthesized were also considered as novel propellant binders. Author

N71-20166*# Techtran Corp., Glen Burnie, Md.
POSSIBLE USE OF ION-EXCHANGE RESINS AS CARRIERS OF PLANT NUTRIENTS [IZVCHENIYE VOZMOZHNOSTEY PRIMENENIYA IONOOBMENNYKH SMOL V KACHESTVE NOSITELEY PITATEL'NYKH VESHCHESTV DLYA RASTENIY]
A. A. Zemlyanukhin et al Washington NASA Mar. 1971 13 p refs Transl. into ENGLISH from Tr. Lab. Ionoobmen. Protsessou i Sorbtsii, Nauch.-Issled. Fiz.-Khim. Inst., Voronezh. Gos. Univ. (USSR), no. 1, 1966 p 245–252
(Contract NASw-2037)
(NASA-TT-F-13544) Avail: NTIS CSCL 07C

Experiments indicate that ion-exchange resins KU-2 and AV-17 are not toxic to plants, and cucumbers and tomatoes could receive N, P, Ca, and Mg from these resins. Plants receiving nutrients from resins grew more intensively than those receiving nutrients from solutions. Plants absorbed nitrate and phosphate from the resins easily and Ca(2+) and Mg(2+) more slowly than from nutrient solutions. Author

N71-20167*# Scientific Translation Service, Santa Barbara, Calif.
ION-EXCHANGER-BASED SYNTHETIC NUTRIENT MEDIA FOR GROWING PLANTS [ISKUSSTVENNYYE PITATEL'NYYE SREDY DLYA ROSTA RASTENIY NA OSNOVE IONOOBMENNYKH MATERIALOV]
V. S. Soldatov et al Washington NASA May 1971 15 p refs Transl. into ENGLISH from Agrokhimiya (Moscow), no. 2, 1969 p 101–108
(Contract NASw-2035)
(NASA-TT-F-13545) Avail: NTIS CSCL 07C

In the experiment to supply plant nutrients as adsorbed cations and anions on synthetic resins, a strongly acidic resin KU-2 and the anion resin EDE-10 were used. Both exchangers have high mechanical strength and chemical stability and are not decomposed by oxygen and light at ordinary temperatures. The nutrient solutions used to saturate the resins were prepared in well water with a correction for the amount of Mg and Ca salts present. A solution of Fe(NO3)3 (9H2O) (gluconate complex), H3BO3, MnCl2, CuSO4-ZnSO4, (NH4)2MoO4, CaSO4, NiSO4, Ca(NO3)2, KNO3, Mg(SO4) was used to saturate the mixed resins by passing through a packed column. The substrate was used to grow cabbage, carrots, lettuce, and potatoes in a controlled climate at 18–23 deg and 75–80% humidity. No additional fertilizers were applied, and distilled H2O was used for irrigation. The development of the plants was normal and the yield was markedly higher than that of the control plants grown on fertilized peat. Author

N71-20210# McDonnell Aircraft Corp., St. Louis, Mo. Engineering Labs.
METHODS OF DETERMINING RESIDUAL GAS COMPOSITION FROM RESIDUAL GAS ANALYZER DATA
R. H. Lilienkamp *In* NBS Space Simulation Oct. 1970 p 151–164 refs (See N71-20201 09-11)
Avail: SOD $5.25

Three methods of determining residual gas composition from residual gas analyzer data are compared using a computer simulation to generate the data for analysis. Typical vacuum system gas mixtures and errors from shot noise were simulated. Errors were also introduced into the calibration data used to interpret the RGA data. The first method is an iteration technique which proved to be inferior to the other methods. The second is a matrix inversion method which worked well for the gases used in this study but which must be evaluated for each gas mixture. The third method is a multiple regression analysis giving least squares fit to the data. This method uses all of the data from the RGA and is usable with any mixture of gases. The effect of the calculation of the residual gas composition is also shown. Author

N71-20286*# Air Products and Chemicals, Inc., Allentown, Pa.
AN ECONOMIC STUDY OF OXYGEN DIFLUORIDE Final Report, 4 Jun. 1969 – 4 Jun. 1970
F. L. Hyman and J. F. Tompkins Nov. 1970 63 p refs
(Contract NASw-1911)
(NASA-CR-117317) Avail: NTIS CSCL 07D

The cost of producing oxygen difluoride is evaluated, based on a review of four methods. These methods are: fluorine-caustic, fluorine-water catalyzed by alkali fluorides, electrolysis of water in hydrogen fluoride, and electrolysis of oxygen in hydrogen fluoride using a porous anode. It is concluded that the fluorine-caustic offers the least expensive method for making oxygen difluoride at rates at or below 10,000 lb/yr. Author

N71-20287*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CONTROL OF NITROGEN DIOXIDE IN STACK EMISSION BY REACTION WITH AMMONIA
Allen J. Metzler Washington Mar. 1971 15 p refs
(NASA-TM-X-2257; E-6063) Avail: NTIS CSCL 07D

Research rocket operations released nitrogen dioxide (NO_2) containing stack gases to the atmosphere. To eliminate the potential hazard of this release, a gas-phase reactor system was developed which used anhydrous ammonia to convert the NO_2 to ammonium nitrate. When an excess of ammonia was used, a reaction time of about 7.5 seconds resulted in the removal of an estimated 99 percent of the NO_2 initially present. An exhaust treatment system is proposed which would recover the excess ammonia and remove the ammonium nitrate formed, so that the exhaust emission would not be visible. Author

N71-20380# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Physics.
MOESSBAUER EFFECT AND OPTICAL FLUORESCENCE STUDY OF Fe(3 +) in LiAl5O8
P. James Viccaro Oct. 1970 124 p refs
(Contract N00014-67-A-0314-0005)
(AD-716054; TR-9) Avail: NTIS CSCL 7/4

Fe-57(3+) Mossbauer effect absorption spectra were collected for powder specimens of LiFe(x)Al(5-x)O8 with $0 \leq x <$ or = to 5 and optical measurements were made of the fluorescence and excitation spectra of Fe(3+) for x = 0.004 and 0.005 ordered and disordered phase compounds. For ordered specimens with $x < 0.01$, the paramagnetic hyperfine spectrum is unusually well defined over the temperature range of 4.2 K to 300 K. The effects on the spectrum of external magnetic fields with strengths less than kOe are interpreted in detail. The perturbing effects of dipolar fields originating from neighboring nuclei are also considered. The ground state hyperfine couplong constant and the quadrupole interaction energy were determined to be −2.45 mm/sec and 0.67 mm/sec + or − 0.03 mm/sec respectively, and the spin Hamiltonian parameters determined are compared to previously reported EPR results. The Mossbauer effect spectra for the disordered phase compounds with x = 0.004 and 0.25 are presented. Author

N71-20588# Harvard Univ., Cambridge, Mass. Dept. of Chemistry.
NONEQUILIBRIUM CONTRIBUTION TO THE RATE OF REACTION. 3. ISOTHERMAL MULTICOMPONENT SYSTEMS
B. Shizgal and M. Karplus (Leiden Rijksuniversiteit) [1970] 21 p refs
(HUX-3780-31) Avail: NTIS

The nonequilibrium contribution to the reaction rate of an isothermal multicomponent system is obtained by solution of the appropriate Chapman-Enskog equation. The system is composed of reactive species in contact with a heat bath of inert atoms M. It is found that the perturbation of the velocity distribution functions is determined by the extent of the departure of the reactive collision frequency for each reactive component from the collision frequency that leaves the distribution function unaltered by reaction. An illustrative application is made to a model system corresponding to the H2+Cl = HCl+H reversible reaction without internal degrees of freedom; the deviation of the rate coefficient ratio from the equilibrium value is a few percent. Author

N71-20598# Atlantic Richfield Hanford Co., Richland, Wash.
PYROCHEMICAL PROCESS FOR THE REDUCTION OF PLUTONIUM DIOXIDE TO METAL
R. E. Felt 15 May 1970 18 p refs Presented at the 63rd Natl. Meeting of the Am. Inst. of Chem. Engr., Chicago
(Contract AT(45-1)-2130
(ARH-SA-72; CONF-701103-6) Avail: NTIS

A pyrochemical process was developed for reducing plutonium dioxide directly to metal with calcium and a salt flux. Direct oxide reduction eliminates several intermediate processing steps that generate waste streams requiring further processing. Waste recovery is nearly eliminated by this method of producing plutonium metal. The process was demonstrated by producing 2000 grams of plutonium metal. Further equipment development is required to make the process operational. Author (NSA)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N71-19390# Queen's Univ., Kingston (Ontario). Dept. of Mathematics.
SIGNAL DETECTION IN THE PRESENCE OF COCHANNEL INTERFERENCE AND NOISE
Michael John Wilmut Oct. 1970 80 p refs
(Contract DSS-OJPO-13)
(RR-70-3) Avail: NTIS

Binary signal detection is considered in the presence of white Gaussian noise and interfering signals. The results apply most directly to co-channel interference; however, the models might also be viewed as describing an intersymbol interference situation. An analysis is made for two important practical cases: first, the desired and interfering signals are known exactly and second the desired signal is known exactly but the interfering signal has unknown random phase. The Bayes Criterion for both cases yields a detection scheme in which the probability of error determination is extremely difficult if not impossible. Hence, for calculation purposes, a class of linear receivers is considered. The error distribution function is known, and the optimum receiver is found; in this case, the correlation receiver. The performance and properties of two other detection schemes, also in the above class, the maximum detector and standard receiver are investigated. Author

N71-19407*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 13 MISSION HIGH-GAIN ANTENNA ACQUISITION PROBLEM: ANOMALY REPORT
Dec. 1970 13 p
(NASA-TM-X-66903; MSC-03753) Avail: NTIS CSCL 09E

The difficulty experienced in obtaining high-gain acquisition and subsequent tracking during the Apollo 13 flight is discussed. The possible causes for the problem which were rejected by system analysis are listed. It is concluded that a short occurred in the primary winding of the C-axis induction potentiometer which resulted in a shift in the scan-limit and scan-limit-warning functions. Tests have been added at the launch site to ensure proper scan-limit and scan-limit warning functions prior to flight. F.O.S.

N71-19425*# Kansas Univ., Lawrence. Engineering Science Div.
BROAD-SPECTRUM ELECTROMAGNETIC BACKSCATTER
William P. Waite Aug. 1970 172 p refs
(Contracts NAS9-10261; DAAK02-68-C-0089)
(NASA-CR-117035; CRES-TR-133-17) Avail: NTIS CSCL 20C

Continuous spectral responses of natural and manmade targets and surfaces were measured to examine the fine grain and gross variations with frequency of the backscattered return. Averaging in frequency, or effective panchromatic illumination, was studied as a means of reducing the variance of the fine grain or fading variations. In addition, the use of multiple panchromatic bands, or polypanchromatic illumination, was considered as a recognition means for the underlying spectral response remaining after fading effects were removed. The frequency variation of a discrete scatterer model was examined for a variety of illuminating conditions ranging from monochromatic through bandwidths far in excess of resolution requirements. The theoretical reduction in return variance was shown to be a function of the resolution bandwidth and illumination bandwidth ratio. The spectral response variations remaining after the removal of fading affects were normalized and compared with similar response characteristics from the visual and infrared regions. Author

N71-19433* Hayes International Corp., Huntsville, Ala.
AUTOMATIC CLOSED CIRCUIT TELEVISION ARC GUIDANCE CONTROL Patent
William A. Wall, Jr. and Douglas L. Stephens, inventors (to NASA) Issued 6 Oct. 1970 (Filed 5 Oct. 1967) 8 p Cl. 178-6; Int. Cl. B23k7/10, 37/02, 5/36 Sponsored by NASA
(NASA-Case-MFS-13046; US-Patent-3,532,807; US-Patent-Appl-SN-673228) Avail: US Patent Office CSCL 17B

A method is described for automatically welding a work piece by using a closed circuit television as a guidance system. With the television viewing the work surface, the reflected light pattern from a weld joint is focused through a lens system onto an array of photo cells, causing the brightest light source received by the television to come from the joint to be welded. With a blanking circuit to eliminate errors caused by light reflected from scratches and rough spots, all that is left is the television signal voltage generated from the bright weld joint along the single line of scan. As the weld torch is moved along the surface, corrections are made by counting the position of the line of scan containing reflections from the weld point and converting a change in position of the reflections to an analog voltage. A servomotor can be driven by the analog voltage to correct variations in position of the weld torch. Official Gazette of the U.S. Patent Office

N71-19436* North American Aviation Inc., El Segundo, Calif.
RADIO FREQUENCY SHIELDED ENCLOSURE Patent
Hinland Young, inventor (to NASA) Issued 23 Jun. 1970 (Filed 12 Dec. 1968) 4 p Cl. 174-35; Int. Cl. H05k9/00 Sponsored by NASA
(NASA-Case-XMF-09422; US-Patent-3,517,109; US-Patent-Appl-SN-783378) Avail: US Patent Office CSCL 17B

A method and apparatus for improvement of radio frequency shielding of enclosures are described. This is accomplished by bowing of instrument panels to overcome the natural tendency of the panels to bow outward between the points of attachment along their sides. Tapered shims are inserted behind the sides of a panel covering an enclosure opening, to mechanically bow the panel and to contain electromagnetic waves at the sides of the panel. When the attaching bolts are tightened the convex inside surface of the bowed panel exerts a force along the top and bottom of the panel against a radio frequency interference gasket, which in turn exerts a counter force against the panel. These opposing forces straighten the bow in the panel so as to cause a portion of the panel touching the chassis to form a planar surface exerting uniform contact pressure on the radio frequency interference gasket, along the top and bottom of the enclosure opening. Official Gazette of the U.S. Patent Office

N71-19493* National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
WEATHERPROOF HELIX ANTENNA Patent
Herbert E. Cribb, inventor (to NASA) Issued 28 Apr. 1970 (Filed 21 Jun. 1967) 5 p Cl. 343-873; Int. Cl. H01q1/36
(NASA-Case-XKS-08485; US-Patent-3,509,578; US-Patent-Appl-SN-649078) Avail: US Patent Office CSCL 09E

A helical antenna constructed of a flexible weatherproof cable is described. The cable is flexible enough to be bent into the shape of a helix about standoff insulators, yet substantially rigid enough to retain such shape after so bending. The antenna is movably mounted on a stand for appropriate orientation in any direction. Official Gazette of the U.S. Patent Office

N71-19525# Rome Air Development Center, Griffiss AFB, N.Y.
N-DIMENSIONAL GENERATOR CONCEPT Final Technical Report, 1969 – 1970
Arnold E. Argenzia Nov. 1970 75 p refs
(AD-716558; RADC-TR-70-263) Avail: NTIS CSCL 9/4

The desire for improved spread-spectrum modulation communication systems has led directly into a conceptualization of a general multiple linear-logic shift-generator model over a Galois field GF(g) of g elements. This model is constructured and one of its progenies, the multiple linear-logic serial-output shift-register generator over a Galois field GF(0, 1) of two elements is analyzed for one set of parameters: m = omega sub 1 = 2 and omega sub 1 = 1. The results are (1) longer binary sequences than the maximal length L = ((2 to the power r)-1) binary sequences associated with the fixed linear-logic networks, (2) larger classes of binary sequences than the Euler Phi-function phi((2 to the power r)-1)/r classes of binary sequences associated with the fixed linear-logic networks. Author (GRA)

N71-19526# Advisory Group for Aerospace Research and Development, Paris (France).
INFORMATION ANALYSIS CENTRES
Feb. 1971 59 p refs Conf. held at Amsterdam, 10 Nov. 1970
(AGARD-CP-78-71) Avail: NTIS

CONTENTS:

1. CONCEPT MISSION, AND OPERATION OF SCIENTIFIC AND TECHNICAL INFORMATION ANALYSIS CENTERS J. W. Murdock (Battelle Memorial Inst., Columbus, Ohio) 14 p (See N71-19527 09-07)

2. FUNDING INFORMATION ANALYSIS CENTERS G. S. Simpson, Jr. (Battelle Memorial Inst., Columbus, Ohio) 4 p (See N71-19528 09-07)

3. A SPECIALIZED DOCUMENTATION CENTER: ITS ORGANIZATION, ITS METHODS, ITS EFFECTIVENESS Y. J. Roeper (Societe Nationale Industrielle Aerospatiale, Paris, France) 11 p (See N71-19529 09-07)

4. THE HARWELL HEAT TRANSFER AND FLUID FLOW

INFORMATION ANALYSIS CENTRE L. B. Cousins (UKAEA, Harwell, England) 8 p (See N71-19530 09-33)

5. PROPOSAL FOR AN INTERNATIONAL AIR POLLUTION INFORMATION ANALYSIS CENTER J. W. Murdock (Battelle Memorial Inst., Columbus, Ohio) 5 p (See N71-19531 09-13)

6. MARITIME POLLUTION R. P. Langston (Admiralty Oil Lab., Cobham, England) 7 p refs (See N71-19532 09-13)

N71-19527# Battelle Memorial Inst., Columbus, Ohio.
CONCEPT, MISSION, AND OPERATION OF SCIENTIFIC AND TECHNICAL INFORMATION ANALYSIS CENTERS
J. W. Murdock *In* AGARD Inform. Analysis Centers Feb. 1971 14 p (See N71-19526 09-07)
Avail: NTIS

A discussion is given of the fundamental concepts of an information analysis center (IAC) and how it relates to other information services. The mission of an IAC is considered in terms of how unpublished information is obtained and used, and how feedback helps the IAC achieve its goals. Operational aspects of a center are reviewed, and experiences by research scientists and engineers in utilizing an IAC are related. Two non-government supported IAC's are described along with one government center. The advantages of working in an IAC environment, key problems in day-to-day operation, and the ever present problem of money are included in the discussion. D.L.G.

N71-19528# Battelle Memorial Inst., Columbus, Ohio.
FUNDING INFORMATION ANALYSIS CENTERS
G. S. Simpson, Jr. *In* AGARD Inform. Analysis Centres Feb. 1971 4 p (See N71-19526 09-07)
Avail: NTIS

An overview is presented of the funding problems involved in the implementation and maintenance of an information analysis center. It is pointed out that: (1) the centers are expensive to operate, (2) adequate funding is difficult to obtain and keep, and (3) the centers cannot be economically justified for every aspect of science and engineering. Another basic problem involves the difficulty in acquiring detailed data cost from facilities that are presently in operation. Emphasis of the discussion is placed on factors that determine whether an information analysis center is needed, what size it should be, and whether it should be funded by government sources or private industry. D.L.G.

N71-19529# Societe Nationale Industrielle Aerospatiale, Paris (France). Div. Systemes Balistiques et Spatiaux.
A SPECIALIZED DOCUMENTATION CENTER: ITS ORGANIZATION, ITS METHODS, ITS EFFECTIVENESS [UN CENTRE DE DOCUMENTATION SPECIALISE: SON ORGANISATION, SES METHODES, SON EFFICACITE]
Y. J. Roeper *In* AGARD Inform. Analysis Centres Feb. 1971 11 p In FRENCH; ENGLISH summary (See N71-19526 09-07)
Avail: US Patent Office

The establishment and operation procedures are described for a documentation center dealing with aerospace data. Discussions are given concerning: (1) the need for such a center, (2) the documentation chain employed, (3) the automatization involved, and (4) cost effectiveness. In addition, some figures are provided to illustrate the cost of automatic documentation. D.L.G.

N71-19546*# Ohio State Univ. Research Foundation, Columbus.
SECOR OBSERVATIONS IN THE PACIFIC
Ivan I. Mueller, James P. Reilly, Charles R. Schwarz, and Georges Blaha Aug. 1970 42 p refs
(Grant NGL-36-008-003)
(NASA-CR-117043; Rept-140) Avail: NTIS CSCL 17I

The geometric adjustment technique used to perform SECOR data adjustments is based on the theory of least squares. All data must be observed from four SECOR ground tracking stations simultaneously. Directional, relative position, station position, and height constraints are discussed along with inner constraint equations for the best solution in a coordinate system. Data used in SECOR geometric adjustments are included with a description of the different solutions. J.M.

N71-19550# Air Force Cambridge Research Labs., Bedford, Mass.
PERTURBATION CALCULATION OF THE SCATTERING OF RADIO FREQUENCY WAVES BY AN UNDERDENSE IONOSPHERIC LAYER
Milton M. Klein 5 Oct. 1970 20 p refs *Its* Phys. Sci. Res. Papers No. 430
(AD-716387; AFCRL-70-0538) Avail: NTIS CSCL 20/14

Knowledge and understanding of the propagation of electromagnetic waves through the ionosphere, ionospheric irregularities, and artificial electron clouds provide the Air Force with information and criteria needed for the solution of problems involving discrimination, detection, and communication. Because of the difficulties encountered in obtaining analytic and accurate numerical solutions to problems of practical interest, approximate solutions provide a useful alternative and, in addition, indicate relations among the important parameters which may be obscured in a more complicated solution. The present report is concerned with the application of perturbation techniques to the scattering of electromagnetic waves by an underdense ionospheric layer. Author (GRA)

N71-19578# Naval Research Lab., Washington, D.C.
TROPOSPHERIC FORWARD SCATTER OVER A SEAWATER PATH AT X-BAND, EMPLOYING DIRECTIONAL AND OMNIDIRECTIONAL ANTENNAS
John E. Raudenbush 30 Nov. 1970 26 p refs
(AD-716020; NRL-7184) Avail: NTIS CSCL 17/2

In order to determine the feasibility of employing a troposcatter system at X-band frequencies for naval task-force communications, an experimental circuit was installed over a 72.8-naut-mi, predominately sea water path. Transmission-loss data were collected over a period of one year on this circuit, employing a high-gain parabolic transmitting antenna, and an omnidirectional receiving antenna. Other antenna combinations were also tried for relatively short periods of time. The results of the experiment indicated that with the terminal equipment employed on this experimental link, the percentage of time that satisfactory communication could be obtained would not be adequate for naval task-force requirements. In view of the desired goal of ranges out to 300 naut mi. However, at lesser ranges and with high-gain antennas at each terminal, successful troposcatter circuits at X-band are a definite possibility. The transmission-loss data obtained from the conduct of this experiment should be useful for extrapolation to estimate the performance of systems employing improved terminal equipment and more sophisticated transmission techniques. Author (GRA)

N71-19638* Hughes Aircraft Co., Culver City, Calif.
PARAMETRIC ANALYSIS OF MICROWAVE AND LASER SYSTEMS FOR COMMUNICATION AND TRACKING. VOLUME 2: SYSTEM SELECTION
L. S. Stokes, K. L. Brinkman, and F. Kalil, eds. Washington NASA Feb. 1971 283 p refs
(Contract NAS5-9637)
(NASA-CR-1687) Avail: NTIS CSCL 17B

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1. MISSION ANALYSIS AND METHODOLOGY, PART 1 86 p (See N71-19639 09-31)
2. SYSTEM THEORY, PART 2 86 p (See N71-19640 09-07)
3. COMMUNICATION SYSTEMS OPTIMIZATION METHODOLOGY, APPENDIX A 36 p (See N71-19641 09-07)
4. COPTRAN, APPENDIX B 68 p (See N71-19642

09-07)

5. For Volume 1, see N70-42715; for Volume 3, see N71-19643; for Volume 4, see N71-17582.

N71-19640*# Hughes Aircraft Co., Culver City, Calif.
SYSTEM THEORY, PART 2

In its Parametric Analysis of Microwave and Laser Systems for Commun. and Tracking, Vol. 2 Feb. 1971 86 p (See N71-19638 09-07)

Avail: NTIS CSCL 17B

The basic equations which describe modulation and demodulation implementations are presented. The performance of these implementations is considered in the presence of various types of noise contributions. In practice many optical and radio communications systems have been constructed and the theoretical performance compared to experimental measurements. The correlation has been good with small degradation allowed for hardware imperfections. It is not practical therefore to describe one type of implementation as better than another without listing all the conditions which are required to describe the theoretical performance. Author

N71-19641*# Hughes Aircraft Co., Culver City, Calif.
COMMUNICATION SYSTEMS OPTIMIZATION METHODOLOGY, APPENDIX A

In its Parametric Analysis of Microwave and Laser Systems for Commun. and Tracking, Vol. 2 Feb. 1971 36 p (See N71-19638 09-07)

Avail: NTIS CSCL 17B

The complexity of evaluating the relative roles of systems for future spacecraft communication and tracking applications, considering the broad spectrum of potential manned and unmanned space missions is discussed. The task is one of examining the study data compiled by communication components analysis, and communication systems analysis studies; and then determining the optimum parameters for communication systems. The communication components analysis task provides data on the system parameters with relationship to the fabrication cost, weight, and size, of the component implementation. The communication systems analysis provides the relationships between the communication parameters, noise effects, and system constraints. While the general goals of the systems optimization task can be stated rather simply, its implementation requires a significant amount of effort due to the large number of parameters that must be considered. Author

N71-19642*# Hughes Aircraft Co., Culver City, Calif.
COPTRAN, APPENDIX B

In its Parametric Analysis of Microwave and Laser Systems for Commun. and Tracking, Vol. 2 Feb. 1971 68 p (See N71-19638 09-07)

Avail: NTIS CSCL 17B

Calculations to determine communication capability of a pulse or digital transmission link are discussed. The calculations are dependent on a single equation which specifies the probability of detection error for one way transmission. While there are variants in this equation to account for different types of noise, modulation and demodulation techniques, this one equation documents the interrelationships among the communication system parameters of range, transmitter power, antenna gains, and noise. In the equation describing the probability of detection error it is possible to trade one system parameter value against others while maintaining a given performance. Thus, it is difficult to determine the best combination of parameters for a particular application although this is an important determination, especially to space missions. An analytical method or methodology of not only selecting parameters which produce the desired performance within the regulation of the range equation but of selecting optimum parameter values which meet the desired performance is presented. Author

N71-19643*# Hughes Aircraft Co., Culver City, Calif.
PARAMETRIC ANALYSIS OF MICROWAVE AND LASER SYSTEMS FOR COMMUNICATION AND TRACKING. VOLUME 3: REFERENCE DATA FOR ADVANCED SPACE COMMUNICATION AND TRACKING SYSTEMS

L. S. Stokes, K. L. Brinkman, and F. Kalil, eds. Washington NASA Feb. 1971 559 p refs
(Contract NAS5-9637)
(NASA-CR-1688) Avail: NTIS HC$6.00/MF$0.95 CSCL 17B

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1. TRANSMITTING POWER SOURCES, PART 1 p 1–116 refs (See N71-19644 09-07)
2. MODULATORS, PART 2 p 117–188 refs (See N71-19645 09-07)
3. DETECTORS, PART 3 p 189–232 refs (See N71-19646 09-07)
4. TRANSMITTING AND RECEIVING APERTURES, PART 4 p 233–327 refs (See N71-19647 09-07)
5. ACQUISITION AND TRACKING, PART 5 p 329–474 refs (See N71-19648 09-07)
6. PRIME POWER SYSTEMS, PART 6 p 475–523 refs (See N71-19649 09-03)
7. HEAT EJECTION SYSTEM, PART 7 p 525–553 refs (See N71-19650 09-33)
8. For Volume 1, see N70-42715; for Volume 2, see N71-19638; for Volume 4, see N71-17582.

N71-19644*# Hughes Aircraft Co., Culver City, Calif.
TRANSMITTING POWER SOURCES, PART 1

In its Parametric Analysis of Microwave and Laser Systems for Commun. and Tracking, Vol. 3 Feb. 1971 p 1–116 refs (See N71-19643 09-07)

Avail: NTIS CSCL 17B

The types, characteristics, and operating parameters of radio frequency and optical transmitting power sources for space tracking and communications systems are discussed. Radio frequency sources include both oscillators and amplifiers. The optical frequency sources include ultraviolet, visible, and infrared laser sources. A detailed theory of selected gas laser sources is presented. Author

N71-19645*# Hughes Aircraft Co., Culver City, Calif.
MODULATORS, PART 2

In its Parametric Analysis of Microwave and Laser Systems for Commun. and Tracking, Vol. 3 Feb. 1971 p 117–188 refs (See N71-19643 09-07)

Avail: NTIS CSCL 17B

A numerical analysis of techniques for signal modulation is presented. Subjects discussed are: (1) radio frequency modulators, (2) optical modulators, (3) electro-optic modulation, (4) electro-optic frequency translators, (5) traveling wave electro-optic modulators, (6) ultrasonic modulators, and (7) elasto-optic modulators. Author

N71-19646*# Hughes Aircraft Co., Culver City, Calif.
DETECTORS, PART 3

In its Parametric Analysis of Microwave and Laser Systems for Commun. and Tracking, Vol. 3 Feb. 1971 refs p 189–232 (See N71-19643 09-07)

Avail: NTIS CSCL 17B

The characteristics of radio frequency detectors are presented. Noise figures for crystal mixers, parametric amplifiers, and masers are given for microwave and millimeter wavelengths. The use of masers and helium cooled parametric amplifiers for very low noise earth receiving of space communication is discussed. The application of optical detectors in laser communication, photomultiplier detectors, and semiconductor devices is described. Author

N71-19647*# Hughes Aircraft Co., Culver City, Calif.
TRANSMITTING AND RECEIVING APERTURES, PART 4
In its Parametric Analysis of Microwave and Laser Systems for Commun. and Tracking, Vol. 3 Feb. 1971 p 233–327 refs
(See N71-19643 09-07)
Avail: NTIS CSCL 17B

The theory and state of the art of radio frequency antennas potentially capable of fulfilling the characteristics dictated by space communication and tracking applications are presented. Antenna theory for large apertures is discussed. The fundamental parameters for characterizing antenna performance are defined. An analysis relating the degradation of performance to phase errors caused by both bending and random distortion of large antennas is given. Antenna types potentially suitable for space communication and tracking applications are described. The performance and relative advantages of the various antenna types for different space applications are discussed. Curves showing degradation of antenna gain as a function of aperture distortion for various types of antennas are given. Author

N71-19648*# Hughes Aircraft Co., Culver City, Calif.
ACQUISITION AND TRACKING, PART 5
In its Parametric Analysis of Microwave and Laser Systems for Commun. and Tracking, Vol. 3 Feb. 1971 p 329–474 refs
(See N71-19643 09-07)
Avail: NTIS CSCL 17B

The effects of mission constraints and receiver location on acquisition and tracking systems for spacecraft communication are presented. Subjects discussed are: (1) signal propagation delays, (2) relative motion between transmitter and receiver, (3) coordinate reference frame error, (4) earth based receiver atmospheric considerations, and (5) acquisition subsystem operational sequence. Author

N71-19673# North Carolina State Univ., Raleigh. School of Engineering.
EFFICIENT DIGITAL ENCODING METHODS FOR IMPROVED MILITARY COMMUNICATION SYSTEMS Interim Progress Report, 2 Apr. –1 Nov. 1970
J. B. O'Neal, Jr. 5 Nov. 1970 14 p
(Contract F44620-69-C-0033)
(AD-715998; AFOSR-70-2606TR) Avail: NTIS CSCL 9/4

The report, containing a brief summary of work on the THEMIS contract, consists of only three parts: (A) Milestones, (B) Reports, Publications and talks and (C) an Appendix containing details of a Picture Coding Symposium. Author (GRA)

N71-19748# RAND Corp., Santa Monica, Calif.
A PANORAMIC VIEW OF IONOSPHERIC REFLECTION AND TRANSMISSION UNDER AMBIENT AND DISTURBED CONDITIONS
H. G. Booker, C. M. Crain, and E. C. Field Nov. 1970 37 p refs
(Contract F44620-67-C-0045)
(AD-716679; R-559-PR) Avail: NTIS CSCL 20/14

The report presents the technical basis used in the development of a computer program for assessing the effects of ambient and disturbed daytime and nighttime ionospheres on the reflection and transmission of radio waves in the 10 to the 10th power to 0.001 Hz frequency range. The ionospheric models and electromagnetic theory used are described, certain limitations are discussed, and the parameters and equations used are summarized. A number of results obtained from the program are presented in graphical form. From these, the existence of height-dependent pass bands, stop bands, and conduction bands in the ionosphere is evident. Also shown are reflection levels and two-way reflection losses. These results provide useful understanding of ionospheric wave propagation, and serve as background material. Author (GRA)

N71-19753# RAND Corp., Santa Monica, Calif.
TRANSMISSION OF ELECTROMAGNETIC WAVES THROUGH NORMAL AND DISTURBED IONOSPHERES
H. G. Booker, C. M. Crain, and E. C. Field Nov. 1970 34 p
(Contract F44620-67-C-0045)
(AD-716678; R-558-PR) Avail: NTIS CSCL 20/14

The report presents the results of an analysis of the transmission of electromagnetic waves through the ionosphere. The objective of the calculations is to provide estimates of the propagation losses to be expected on communication links between satellites and the ground. A wide range of frequencies, 0.001 to 10 to the 10th power Hz, is considered, and normal and disturbed nighttime and daytime conditions are analyzed. The models and computational methods are summarized briefly in Section 2, extensive numerical results for the total transmission loss and height dependence of ionospheric attenuation are presented in Section 3, and the conclusions are given in Section 4. Author (GRA)

N71-19759# Defence Research Board, Ottawa (Ontario).
AN ANNOTATED BIBLIOGRAPHY OF UNCLASSIFIED REPORTS ISSUED BY DEFENCE RESEARCH TELECOMMUNICATIONS ESTABLISHMENT, 1947–1969
W. M. Searle, comp. Dec. 1970 211 p refs
(DSIS-B14) Avail: NTIS

The bibliography contains entries on antennas, communications, earth satellites, electricity and magnetism, meteorology and geophysics, microwaves, ionospheric propagation, radar, and radio astronomy. N.E.N.

N71-19773* IIT Corp., Nutley, N.J.
TIME DIVISION RADIO RELAY SYNCHRONIZING SYSTEM USING DIFFERENT SYNC CODE WORDS FOR IN SYNC AND OUT OF SYNC CONDITIONS Patent
Walter L. Glomb and Donald R. Campbell, inventors (to NASA) Issued 6 Oct. 1970 (Filed 13 Mar. 1968) 15 p Cl. 325-4; Int. Cl. H04b7/20 Sponsored by NASA
(NASA-Case-GSC-10373-1; US-Patent-3,532,985; US-Patent-Appl-SN-712658) Avail: US Patent Office CSCL 17B

A system to enable several stations to gain access to and communicate through a common repeater in a different time slot of a time division multiplex format at the repeater is described. Each of the stations includes a matched filter to produce a master sync pulse identifying the beginning of the format from a distinctive master code word transmitted from one of the stations through the repeater to all other stations. A binary counter responsive to the master sync pulse is preset to provide an output at the end of its counting cycle to produce a pulse identifying the time slot of the format that a particular station is to communicate in. A distinctive station code word is transmitted through the repeater back to the station and used in conjunction with the output of the counter to control the time of transmission from the station so that station burst is transmitted in the selected time slot through the repeater. An arrangement detects an error in the relative timing of the output of the counter and received station code word and causes the transmission of a distinctive low level, amplitude modulated code word which when received from the repeater operates to correct the time of transmission so that there is no appreciable timing error and the station burst is transmitted through the repeater in its selected time slot. Official Gazette of the U.S. Patent Office

N71-19774# Army Foreign Science and Technology Center, Washington, D.C.
HANDBOOK OF RADAR ENGINEERING FUNDAMENTALS
V. Ya. Tsylov 25 Jun. 1970 704 p refs Transl. into ENGLISH of the book "Spravochnik Po Osnovam Radiolokatsionnoi Tekhn." Moscow, Mil. Publishing House, 1967
(AD-716660; FSTC-HT-23-1114-70) Avail: NTIS CSCL 17/9

The handbook contains information on various questions concerned with radar theory and engineering, control systems, communications, and instruments. Physical fundamentals, operating principles, circuit construction, technical data, indices and criteria for evaluating radio frequency engineering installations, their stages, and elements, are discussed in a practical way. Formulas for evaluations and computing certain of the parameters of radio frequency engineering installations are also cited. Author (GRA)

N71-19854* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TRACKING ANTENNA SYSTEM Patent

William Korvin and Milton K. Mills, inventors (to NASA) Issued 13 Oct. 1970 (Filed 1 May 1969) 10p Cl. 343-100; Int. Cl. H01q3/26

(NASA-Case-GSC-10553-1; US-Patent-3,534,365; US-Patent-Appl-SN-820963) Avail: US Patent Office CSCL 09E

A conically scanned antenna system comprising a multiplicity of waveguide feed elements is described. The elements are arranged in an annular array for exciting a reflector system which generates a secondary radiation beam. The array includes elements extending radially, as well as circumferentially. An excitation network is provided whereby a plurality of elements is simultaneously excited. The beam is scanned both radially and circumferentially, by an excitation network including means of removing excitation from some of the elements while applying excitation to adjacent previously unexcited elements and elements which remain excited. In the center of the annular array, there is provided a separate array for tracking to the reflector boresight axis. The array can be mounted on a synchronous satellite or on a ground based radar. Official Gazette of the U.S. Patent Office

N71-20080# National Physical Lab., New Delhi (India). Radio Science Div.

ELECTRON CONTENT MEASUREMENTS FROM FARADAY FADING OF SATELLITE TRANSMISSIONS DURING LOW AND HIGH SOLAR ACTIVITY

Tuhi Ram Tyagi and Y. V. Somayajulu May 1970 18 p refs (RSD-52) Avail: NTIS

Ionospheric electron contents were measured at Delhi utilizing the Faraday fading of Explorer-22 transmissions for the period Oct. 1964 through Feb. 1969. The average maximum values of electron content for low solar activity period during winter and summer are 1.45 x 10 to the 17th power/m sq and 3.25 x 10 to the 17th power/m sq and the average minimum values are 0.18 x 10 to the 17th power/m sq and 0.25 x 10 to the 17th power/m sq, respectively. No seasonal anomaly exists during low solar activity period in contrast to its presence during high solar activity period during daytime. The electron content values are found to be independent of magnetic activity both during low and high solar activity. During low solar activity the electron content is also independent of solar flux (10.7 cm) until the flux reaches about 100; a positive correlation is found for further increase in solar activity. Author

N71-20121*# Transportation Systems Center, Cambridge, Mass.

ATMOSPHERIC TRANSMISSION HANDBOOK: A SURVEY OF ELECTROMAGNETIC WAVE TRANSMISSION IN THE EARTH'S ATMOSPHERE OVER THE FREQUENCY (WAVELENGTH) RANGE 3 kHz (100 km)-3000 THz (0.1 micron m)

William I. Thompson, III Feb. 1971 296 p refs Sponsored by NASA

(NASA-CR-117173; DOT-TSC-NASA-71-6) Avail: NTIS CSCL 20N

Material on electromagnetic wave transmission in the earth's atmosphere is presented with emphasis on earth-to-space paths up to January 1970. Basic background information is given dealing with transmission fundamentals, the properties of electromagnetic waves, the electromagnetic spectrum, and the earth's atmosphere. A guide to information is included on the transmission properties of the earth's atmosphere to electromagnetic radiation. A list of tables of contents of several books and major articles on atmospheric transmission cited. Selected transmission information is summarized on refraction, absorption, and scattering. Author

N71-20161*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GODDARD SPACE FLIGHT CENTER MOBILE FM/FM TELEMETRY GROUND STATION H CAPABILITY REPORT, REVISION 1

B. F. Karmilowicz Oct. 1970 85 p Revised

(NASA-TM-X-65459; X-743-70-374-Rev-1) Avail: NTIS CSCL 09F

The functions, characteristics, and specifications of the telemetry, recording, and accessory equipment are described. Photographs of the outside of the trailer and of the inside, showing the housekeeping equipment, are included, along with trailer and housekeeping specifications. Author

N71-20162# State Inst. for Technical Research, Helsinki (Finland).

TRANSMISSION CALCULATIONS FOR INFRARED-OPTICAL LINKS

Jan Ekberg 1970 31 p refs

(Publ-157) Avail: NTIS

The possibilities of optical links are analyzed by the derivation of expressions for the optical power and the signal to noise ratio at the receiver. Signal to noise ratios are developed for coherent and noncoherent transmission systems, and the ratio for coherent optical transmission is examined with special care. Factors causing optical attenuation are analyzed, emphasizing attenuation by rain and snow for which equations were derived and checked by measurement. Comparisons are made between a coherent optical link, a noncoherent optical link, and a microwave link. Author

N71-20163*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

REDUCTION OF MUTUAL COUPLING USING PERFECTLY CONDUCTING FENCES

R. J. Mailloux Washington Mar. 1971 27 p refs

(NASA-TN-D-5914; C-132) Avail: NTIS CSCL 09E

The use of thin perfectly conducting fences to reduce the mutual coupling of two parallel plane waveguides radiating through a ground plane is investigated. The E-plane coupling of parallel planes with TEM mode propagation, and the H-plane coupling of parallel planes with the fundamental TE mode propagation were studied. The analysis accounts for a number of higher order modes in the waveguide apertures and uses a Fourier series approximation to the fence currents. Close agreement with experiment is demonstrated. Author

N71-20168# Academy of Sciences (USSR), Moscow. Inst. Atomnoi Energii.

MULTIPLE CHANNEL SYSTEM OF TWO DIRECTIONAL COMMUNICATION FOR THE MEASURING CENTER AT THE CYCLOTRON WITH THE TsVM (CENTRAL COMPUTER) TYPE M-220A [MNOGOKANALNAYA SISTEMA DVUKHSTORONNEJ SVYAZI IZMERITELNOGO TSENTRA PRI TSIKLOTRONE S TSVM M-200 A]

Yu. N. Belyaev, A. A. Vinogradov, A. Ya. Volodenkov, A. A. Kurashov, A. V. Malygin et al. 1970 20 p refs In RUSSIAN

(IAE-1953) Avail: AEC Depository Libraries

A two-directional communication system for the measuring center at the IAE cyclotron with the TsVM type M-220 A located in the computer center of the institute is described. The information

accumulated in a memory-storing device by an impulse analyzer or on magnetic tape is transmitted parallel in a dual code over telephone cable. The length of the connecting line is 1100 meters. The speed of information transmission is determined by the rapid-acting memory-storing device which compiles 30,000 18-charged words per second. Verification of the transmitted and received codes is done by comparing the controlled sums. Author (NSA)

N71-20281*# Raytheon Co., Lexington, Mass.
EXPERIMENTAL DATA BUS COMMUNICATIONS SYSTEM Final Report
Victor Neisenbloom 8 Feb. 1971 107 p
(Contract NAS8-25644)
(NASA-CR-103073; ER71-4059) Avail: NTIS CSCL 17B

The experimental data bus system (EDB) is described. It was designed to provide a unified high speed data transmission system for remote data acquisition and data transmission. Design emphasis was placed on the development of a versatile and representative system to be used as an engineering evaluation tool. The EDB system exercises up to 16 remote units, each having standardized analog and digital interfaces. The system is characterized as a TDM, bit synchronized system employing conditioned diphase modulation. Control, timing, and data are transmitted at a nominal 850 KBps rate. Author

N71-20335# Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).
SYSTEM FOR LOCATING AND RECOVERING RADIO TELEMETRY EQUIPMENT ON ROCKETS [SISTEMA DE BUSQUEDA Y RECUPERACION DE CABEZAS RADIOTELEMETRICAS]
R. M. Cajal 1969 13 p In SPANISH *Its* Informe de Contrato
Avail: NTIS

A proposed system for mounting a locater transmitter receiver on a rocket for recovery purposes is presented. The antenna and receiver equipment are described for use on air to air, or ground to air missiles. Transl. by F.O.S.

N71-20397# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
AN ANALYSIS OF THE WAVE INTERACTION DISTURBING ANTENNA SYSTEM
M. J. Fithian 31 Jan. 1971 113 p refs *Its* Scientific Rept. No. 367
(Grant NSF GA-1456)
Avail: Issuing Activity

The wave interaction of a disturbing antenna system is studied. The system is a linear, broadside array of 1.3 lambda elements with .5 lambda parasitic directors. It is designed to operate at a frequency of 4.5 MHz. The theoretical radiation patterns of the array are derived and plotted for the designed frequency and the second and third harmonics. Using a scale model, the radiation patterns are obtained experimentally for the three frequencies. Various modifications are made on the model which simulate the same changes on the full-scale system. These changes were made to test whether the existing system could be improved. At the harmonics, it was found that the side lobes increase and that most of the energy is radiated off the vertical. A marked improvement in the beamwidth and side-lobe level of the system at the fundamental occurred if reflectors were used with the driven elements. Author

N71-20494*# Autonetics, Anaheim, Calif.
PLANETARY TERMINAL DESCENT AND LANDING RADAR Final Report
Jan. 1971 251 p
(Contract NAS1-7696)
(NASA-CR-111861; C71-52/301) Avail: NTIS CSCL 17I

A model R146-A bi-mode radar configured to provide three-dimensional velocity readout and to indicate slant range to the ground over a wide range of velocities and altitudes is described. The test results indicated a lower operating limit of approximately 100-ft altitude in the J sub 3 Bessel sideband mode. The system was modified to provide switch selectable operation in J sub 1, J sub 2, or J sub 3 Bessel sideband modes and was then flight tested in a helicopter. The results of this flight test indicated performance degradation due to the poor sidelobe structure of the Luneberg lens. Dual constant K antennas were fabricated and the system was configured to permit operation in either a single or dual antenna configuration. The system was again flight tested and good performance was obtained. Three-dimensional tracking of both positive and negative velocities down to zero ft/sec were obtained with an average error of less than 1.5 ft/sec corresponding to approximately 0.218 percent of full scale (680 ft/sec). Altitude performance was measured from 10,000 ft to touchdown using on-board instrumentation and ground truth data. Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N71-19420* Kinelogic Corp., Pasadena, Calif.
TAPE GUIDANCE SYSTEM AND APPARATUS FOR THE PROVISION THEREOF Patent
Irving Karsh and Rubin Shatazsky, inventors (to NASA) Issued 21 Apr. 1970 (Filed 17 May 1967) 9 p Cl. 226-190; Int. Cl. B65H17/20, 23/04; Int. Cl. G11b15/60 Sponsored by NASA Prepared for JPL
(NASA-Case-XNP-09453; US-Patent-3,507,436; US-Patent-Appl-SN-640448) Avail: US Patent Office CSCL 14C

A tape guidance system for multichannel digital recording systems having utility for minimizing the effects of dynamic skew is described. The guidance system includes a groove which is provided in the tape backing. This groove travels on stylii located adjacent the transducer in the tape transport. The guidance groove is formed in the tape backing by an apparatus which includes a stylus, mounting structure for the stylus, and tape transport structure which mounts the tape and moves the tape past the stylus for forming a longitudinal groove in the tape backing. Since dynamic skew is a function of the straightness of the groove formed in the tape backing, the apparatus provided for forming the groove in the tape is provided with the capability of forming a precisely formed groove so that dynamic skew is thereby reduced to a minimum. Official Gazette of the U.S. Patent Office

N71-19432* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SYNCHRONOUS COUNTER Patent
Duane K. McDermond, inventor (to NASA) Issued 23 Jun. 1970 (Filed 24 Jul. 1967) 8 p 328-42; Int. Cl. H03k21/06, 23/04
(NASA-Case-XGS-02440; US-Patent-3,517,318; US-Patent-Appl-SN-655677) Avail: US Patent Office CSCL 09B

The synchronous counter is described which is composed of a plurality of cascaded binary stages, each of which, except the first, is driven by the previous stages and an input source through a NAND gate. Each NAND gate is connected directly to the input pulse source and to the output of the preceding flip-flop, as well as to complementary outputs of all of the other preceding flip-flops. A digitally controlled oscillator driven by the counter as described is also outlined. Official Gazette of the U.S. Patent Office

N71-19435* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
WIDE RANGE DATA COMPRESSION SYSTEM Patent
Ciro A. Cancro, inventor (to NASA) Issued 28 Apr. 1970 (Filed 22 Oct. 1965) 10 p Cl. 340-347; Int. Cl. H03b3/02
(NASA-Case-XGS-02612; US-Patent-3,509,558; US-Patent-Appl-SN-502743) Avail: US Patent Office CSCL 09B

An attenuator system for data compression is described in which the output is within a predetermined range of magnitude for application to a device such as an analog-to-digital converter. The signal to be compressed is applied to both arms of the parallel system; in one portion of the system the signal being delayed while in the other portion, the magnitude of the signal is measured. The output from a range detector, which measures the amplitude, is fed to a control network which controls the level of attenuation applied on the delayed input signal. The output of the system is then transmitted to an analog-to-digital converter. The combined digital signal yields complete transmission of the information contained in the intput analog signal. D.L.G.

N71-19437* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPARATUS FOR COMPUTING SQUARE ROOTS Patent
Rodger A. Cliff, inventor (to NASA) Issued 21 Apr. 1970 (Filed 30 Nov. 1966) 7 p Cl. 235-158; Int. Cl. G06f7/38
(NASA-Case-XGS-04768; US-Patent-3,508,039; US-Patent-Appl-SN-598119) Avail: US Patent Office CSCL 09B

•An apparatus for obtaining a square root of a number wherein two binary registers are selectively interconnected by gates so that a numerical progression is subtracted from one register which contains a number the square root of which is described. Author

N71-19533*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
AZUSA GDOPS PROGRAM AZGD2, PROGRAM LIBRARY NUMBER 1016
14 Aug. 1970 60 p refs
(NASA-TM-X-66905; GP-832) Avail: NTIS CSCL 09B

The AZUSA Geometric Dilution of Precision (GDOPS) Program (AZGD2) is designed to compute GDOPS for a standard KSC theoretical trajectory based on an AZUSA (or AZUSA-like) system. Internally the AZGD2 program uses a right-handed cartesian coordinate system located at the original geographic origin with X downrange at some azimuth from north, Z crossrange 90 deg greater than the azimuth of X, and Y perpendicular to the XZ plane. The output may be in this coordinate system or in the so called Apollo Saturn Coordinate System, which differs from the aforementioned system only in that its Z is downrange, its Y is crossrange, and its X is perpendicular, i.e., the axes are relabeled. Author

N71-19535# Ecole Nationale Superieure Des Mines, Paris (France). Centre d'Automatique.
GENERALIZED INVERSION AND AUTOMATA MORPHISMS, PART 1
M. Depeyrot Jul. 1970 38 p refs
(Contract F61052-70-C-0023)
(AD-716491; A-20-Pt-1; AFOSR-70-742TR-Pt-1) Avail: NTIS CSCL 6/4

Finite-state system theory is based on two main classes of Automata models: transition-output models (T) are most adequate for identification (they include Mealy sequential machines and Shannon communication channels) while state-output models (S) are best fitted for control or decision theoretic studies. An abstract algebraic approach is classically applied to the latter (S) models and can be extended to the former (T) models. A tensor formulation proves to be handy for the study of (stochastic) infinite operands over a finite carrier and of monoid representation morphisms. Here the categorical properties common to both classes of automata are investigated in the stochastic and deterministic cases, showing how spectral analysis is deeply rooted in the new framework. The main tool is that of generalized inverse matrices of affine type, well fitted for the representation of maps and morphisms with a probabilistic meaning. Author (GRA)

N71-19544* Radiation Instrument Development Lab., Inc., Melrose Park, Ill.
HIGH SPEED BINARY TO DECIMAL CONVERSION SYSTEM Patent
Stanley W. Schorum and Jay R. Wolff, inventors (to NASA) Issued 21 Oct. 1969 (Filed 1 Apr. 1964) 6 p Cl. 340-347; Int. Cl. H03k13/24. Sponsored by NASA
(NASA-Case-XGS-10230; US-Patent-3,474,441; US-Patent-Appl-SN-356488) Avail: US Patent Office CSCL 09B

The system described includes (1) a binary register consisting of a number of subgroup registers that store a preselected portion of the binary number and a least significant digit, (2) a binary to decimal converter connected to each of the subgroup registers, and (3) a decimal register coupled to receive the outputs from the binary to decimal converter. The converter operates with each of the subgroup registers in a predetermined sequence and on the basis of the decimal equivalent of the least significant digit in the register. In this manner, a decimal number equal to the stored binary number is supplied to the decimal register in a relatively few number of steps. D.L.G.

N71-19566*# Colorado State Univ., Fort Collins. Dept. of Chemistry.
THE I(eq ROOT OF t) COMPUTER PROGRAM, APPENDIX 2
In its Electrochem. Studies in Aluminum Chloride Melts 1971 p 81–96 refs (See N71-19562 09-06)
Avail: NTIS CSCL 09B

The loading, operation, and meaning of the parameters used in the program are explained. The program applies a given pulse to an electrochemical system and then records the current at given time intervals. Utilizing the equation for linear diffusion, either the area, concentration, or diffusion coefficient can be calculated provided the other two are known. Plots of current vs time and current times the square root of time vs time, the least squares slope and the intercept of the second plot, and the requested parameter make up the program outputs. Author

N71-19596*# California Univ., Santa Cruz.
A PROPOSED TRANSLATOR WRITING SYSTEM LANGUAGE: COMPUTER PROJECT, VOLUME 3, NO. 1
Franklin L. De Remer Sep. 1970 43 p refs
(Grant NGR-05-061-005)
(NASA-CR-117124; CEP-3-1-Vol-3) Avail: NTIS CSCL 09B

A language is proposed for an advanced translator writing system for use by language designers, as opposed to compiler writers, which will accept as input a formal specification of a language and which will generate as output a translator for the specified language. Although the TWS language is designed primarily for specifying programming languages, and therefore compilers, it is general enough to be found useful in such areas as symbolic mathematics and natural language translation and interpretation. The language is based on an integration of regular expressions, context-free grammars, cascaded transduction grammars, and tree attributes. It provides a single powerful and convenient method for specifying the lexicon, macros, and syntax of a language and the associated translations. Author

N71-19597*# California Univ., Santa Cruz.
SYMBOL TABLE ALGORITHMS: COMPUTER EVOLUTION

PROJECT, VOLUME 2, NO. 1
William M. McKeeman and Ned McDaniel Apr. 1970 56 p
(Grant NGR-05-061-005)
(NASA-CR-117123; CEP-2-1-Vol-2) Avail: NTIS CSCL 09B

Implementation of four methods for accessing symbol tables is presented. Particular attention is given to the problem of local variables resulting from scopes of declarations in ALGOL and PL like languages. Evaluations of the methods are made considering critical resources. Some useful variations and hints toward selecting proper algorithms are discussed. Author

N71-19598*# California Univ., Santa Cruz.
ON USING PAGING: COMPUTER EVOLUTION PROJECT, VOLUME 2 NO. 5
William M. McKeeman Jun. 1970 11 p
(Grant NGR-05-061-005)
(NASA-CR-117122; CEP-2-5-Vol-2) Avail: NTIS CSCL 09B

Much of the utility of paging a computer memory depends upon the ability to execute a program with less than all of its data resident in memory. It is suggested that a considerable improvement in performance, that is, in the amount of memory needed to execute a program for a given quantum of time, can be achieved by using the dynamic sequence of initial program load to keep physically close in memory data that will be accessed close together in time. Author

N71-19599*# California Univ., Santa Cruz.
DATA PROTECTION BY SELF-AWARE COMPUTING SYSTEMS: COMPUTER EVOLUTION PROJECT, VOLUME 2, NO. 6
William M. McKeeman Jun. 1970 8 p
(Grant NGR-05-061-005)
(NASA-CR-117126; CEP-2-6-Vol-2) Avail: NTIS CSCL 09B

Mechanisms are proposed whereby access to proprietary data can be made difficult to the unauthorized user. It is suggested that programs must have the capability to check that they are running on the right computer with the right users and be able to react with alarm when a check fails. Author

N71-19600*# California Univ., Santa Cruz.
SIMPLE LR(k) GRAMMARS: DEFINITION AND IMPLEMENTATION: COMPUTER EVALUATION PROJECT, VOLUME 2, NO. 4
Franklin L. DeRemer Sep. 1970 59 p refs
(Grant NGR-05-061-005)
(NASA-CR-117125; CEP-2-4-Vol-2) Avail: NTIS CSCL 09B

A class of context-free grammars is defined, called the simple LR(k) or SLR(k) grammars, which have been shown to include the weak precedence and the simple precedence grammars as proper subsets. Methods to construct parsers are described for the SLR(k) grammars. These parser constructing techniques have been implemented and by direct comparison have been shown to be superior to precedence techniques, not only in the range of grammars covered, but also in the speed of parser construction and in the size and speed of the resulting parsers. Authors

N71-19687* Hughes Aircraft Co., Los Angeles, Calif.
DRIFT COMPENSATION CIRCUIT FOR ANALOG TO DIGITAL CONVERTER Patent
Donuil A. Hillis, inventor (to NASA) Issued 25 Feb. 1969 (Filed 13 May 1965) 9 p Cl. 340-347; Int. Cl. H04l3/00; Int. Cl. H03k13/02, 17/00 Sponsored by NASA Prepared for JPL
(NASA-Case-XNP-04780; US-Patent-3,430,227; US-Patent-Appl-SN-455477) Avail: US Patent Office CSCL 09B

An apparatus is described for converting mechanical positional information into a digital electrical representation in which the digital output is independent of auxilliary operating voltages. The procedure employed involves the periodic sampling of the electrical output of a resolver driven by a shaft. The sampled output is then compared with a reference signal to produce a signal indicating the mechanical position of the shaft. The sampling duration is varied by a control circuit so as to compensate for any fluctuations in auxilliary voltages. D.L.G.

N71-19724# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
COMPUTING PROGRAMS FOR EQUALIZING LARGE TRIANGULATION NETS [RECHENPROGRAMME ZUR AUSGLEICHUNG GROSSER DREIECKSNETZE]
Dieter Ehlert (Ph.D. Thesis--Tech. Hochsch. Muenchen) 1970 100 p refs In GERMAN
Avail: NTIS

Mathematical and physical aspects in the equalization of the West German part of the European main triangulation net are outlined. Numerical models and several computer programs in ALGOL are presented for calculating equalizing coordinates, for determining improvements of initial observations, and for the formation of sketches. Transl. by G.G.

N71-19754# Singer-General Precision, Inc., Sunnyvale, Calif. Link Div.
DIGITAL DATA RECORDING FOR HUMAN READABLE MACHINE READABLE (HRMR) INFORMATION PROCESSOR Technical Report, 16 Apr. -- 16 Jul. 1970
Nicholas S. Szabo Nov. 1970 113 p refs
(Contract F30602-70-C-0202)
(AD-715983; UC-7240; RADC-TR-70-178) Avail: NTIS CSCL 9/2

The report summarizes work performed during the first ninety days of a study contract for the system design of an information storage and retrieval system. The system is to be able to record both machine readable, as well as human readable information. The first three months of the study were devoted solely to investigating methods for recording digital information on silver halide coated film of microfiche format. In particular, the report examines two methods of recording the information: direct laser recording, using Manchester coding and recording the information in the form of a hologram. For the case of direct recording, film emulsion flaws and reading error probabilities are explored together with methods of coding the information to reduce redundancy. The holographic investigation concentrates on one-dimensional holograms derived by synthetic (computed) techniques. Several different techniques, such as detour phase, superposed gratings, and aperture distribution are examined theoretically. The report also summarizes experimental results which were obtained by synthetically computing the holographic image and recording it on the Link Image Research Laboratory flying spot scanner system. Author (GRA)

N71-19763* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PHASE QUADRATURE-PLURAL CHANNEL DATA TRANSMISSION SYSTEM Patent
Robert M. Munoz, inventor (to NASA) Issued 15 Jul. 1969 (Filed 19 Aug. 1966) 7 p Cl. 325-60; Int. Cl. H04j3/04
(NASA-Case-XAC-06302; US-Patent-3,456,193; US-Patent-Appl-SN-574284) Avail: US Patent Office CSCL 09B

A communication system is described utilizing quadrature modulation and complementary demodulation. The input data is modulated by a modulating oscillator having two quadrature phased signals, and the data is transmitted over two channels to a demodulator which includes a demodulating oscillator. One transmission channel carries the in-phase portion of the modulated data while the second channel carries the quadrature portion of the data. A third channel may be employed to transmit a phase-lock signal between the modulating oscillator and the demodulating

oscillator. The system is capable of transmitting input signals having frequencies which are below, at, or above, the carrier frequency; and the bandwidth of the transmission channels may be less than the bandwidth of the information.

Official Gazette of the U.S. Patent Office

N71-19775*# Radiation, Inc., Ann Arbor, Mich. Electro-Optics Center.

OPTICAL READ/WRITE MEMORY SYSTEM DESIGN Final Technical Report, 5 Aug. 1970–30 Jan. 1971

19 Feb. 1971 96 p refs

(Contract NAS8-26360)

(NASA-CR-103038; Rept-8104-F-1) Avail: NTIS CSCL 09B

During the period, the capacity of a holographic memory system was analyzed in terms of the constructional parameters of the various sytem components and how these parameters are interrelated was determined. The analysis was made for four possible memory configurations to cover any practical systems that may be developed. A similar analysis was made which relates the needed beam deflector optics to the constructional parameters of the system components, with special emphasis on the parameters associated with the acousto-optic beam deflectors. These two studies clearly indicated the correct procedure for designing an optimum memory system, given the operational constraints of available devices. The Gaussian optics for both the memory and the beam deflector optics were then specified. Author

N71-19788*# Autonetics, Downey, Calif.

RECONFIGURABLE G AND C COMPUTER STUDY FOR SPACE STATION USE. VOLUME 1: TECHNICAL SUMMARY Final Report, 29 Dec. 1969–31 Jan. 1971

31 Jan. 1971 40 p refs

(Contract NAS9-10416)

(NASA-CR-114879; C70-171/301-Vol-1) Avail: NTIS CSCL 09B

The general system requirements and the configuration for a modularized reconfigurable, fault tolerant guidance and control computer system suitable for a manned space station complex are presented. The study includes power distribution, modular computing elements at various subsystems, input/output data bus, and the development of necessary software to demonstrate the self-test and reconfiguration ability of the system by computer simulation. A summary of the results of the study is reported. Author

N71-19789*# Autonetics, Downey, Calif.

RECONFIGURABLE G AND C COMPUTER STUDY FOR SPACE STATION USE. VOLUME 2: FINAL TECHNICAL REPORT Final Report, 29 Dec. 1969–31 Jan. 1971

31 Jan. 1971 334 p refs

(Contract NAS9-10416)

(NASA-CR-114880; C70-171/301-Vol-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 09B

For abstract See X71-19788.

N71-19790*# Autonetics, Downey, Calif.

RECONFIGURABLE G AND C COMPUTER STUDY FOR SPACE STATION USE. VOLUME 3, APPENDIX 1: MODEL SPECIFICATION Final Report, 29 Dec. 1969–31 Jan. 1971

31 Jan. 1971 27 p refs

(Contract NAS9-10416)

(NASA-CR-114881; C70-171/301-Vol-3-App-1) Avail: NTIS CSCL 09B

The requirements for the performance of a reconfigurable computer for application in multiple computer and fault tolerant systems are presented. The computer consists of a central processing unit (CPU), a memory system, an input/output processor (IOP), a clock section, memory data bus, and a power converter. The computer provides program storage and necessary circuitry to act as a general purpose computer for use on space stations. Author

N71-19791*# Autonetics, Downey, Calif.

RECONFIGURABLE G AND C COMPUTER STUDY FOR SPACE STATION USE. VOLUME 4, APPENDIX 2: IOP-VCS DETAILED DESIGN Final Report, 29 Dec. 1969–31 Jan. 1971

31 Jan. 1971 175 p refs

(Contract NAS9-10416)

(NASA-CR-114882; C70-171/301-Vol-4-App-2) Avail: NTIS CSCL 09B

The computer system consisting of four computers and four I/O buses that interface with local processors of external subsystems is described. These computers are interconnected for special I/O functions to achieve a Fail Op-Fail Op-Fail Safe (FOOS) computer system. Each computer contains a connection to one of the four external I/O buses in the system. In addition, each computer contains four interconnections: three receive channels, one from each of the other computers, and one out-put channel to all the other computers; it is via these connections that the voter-comparator-switch (VCS) concept is mechanized. Author

N71-19792*# Autonetics, Downey, Calif.

RECONFIGURABLE G AND C COMPUTER STUDY FOR SPACE STATION USE. VOLUME 5, APPENDIX 3: SYSTEM ANALYSIS AND TRADE-OFFS Final Report, 29 Dec. 1969–31 Jan. 1971

31 Jan. 1971 88 p

(Contract NAS9-10416)

(NASA-CR-114883; C70-171/301-Vol-5-App-3) Avail: NTIS CSCL 09B

A detailed report of system analysis studies of the G&C Space Station system is presented. The objective of the system analysis is two-fold: (1) To determine the computer requirements and (2) To perform a performance error analysis of the G&C system. In addition, the results of trade-off studies conducted to determine the distribution and hierarchy of computations in the G&C system are discussed. Author

N71-19793*# Autonetics, Downey, Calif.

RECONFIGURABLE G AND C COMPUTER STUDY FOR SPACE STATION USE. VOLUME 6, APPENDIX 4: SOFTWARE AND SIMULATION DESCRIPTION AND RESULTS Final Report, 29 Dec. 1969–31 Jan. 1971

31 Jan. 1971 169 p refs

(Contract NAS9-10416)

(NASA-CR-114884; C70-171/301-Vol-6-App-4) Avail: NTIS CSCL 09B

A computer simulation program for the reconfigurable guidance and control computer is presented. The simulation program provides a functional, interpretive analysis of the computer system to be used in space station applications. Execution of the simulation consists of reproducing instruction by instruction operation of the central processing and input/output processing units of the computer system while maintaining a pseudo real time reference. Author

N71-19794*# Autonetics, Downey, Calif.

RECONFIGURABLE G AND C COMPUTER STUDY FOR SPACE STATION USE. VOLUME 7, APPENDIX 5: d-200 COMPUTER FAMILY. APPENDIX 6: SYSTEM ERROR ANALYSIS. APPENDIX 7: RELIABILITY DERIVATION FOR CANDIDATE COMPUTERS. APPENDIX 8: POWER CONVERTER DESIGN DATA. APPENDIX 9: DATA TRANSMISSION MEDIUM DESIGN Final Report, 29 Dec. 1969–31 Jan. 1971

31 Jan. 1971 136 p refs

(Contract NAS9-10416)

(NASA-CR-114885; C70-171/301-Vol-7-App-5; C70-171/301-Vol-7-App-6; C70-171/301-Vol-7-App-7; C70-171/301-Vol-7-App-8; C70-171/301-Vol-7-App-9) Avail: NTIS CSCL 09B

The results of a study of orbit determination using correlated horizon sensor measurements are presented. The measurements consist of the angle between the line of sight from the spacecraft to the earth's horizon and a fixed line in inertial space such as the line to an appropriately chosen star. The equations involved in this determination were incorporated into a computer program which was prepared to determine the navigation errors (position and velocity) as a function of several parameters. Author

N71-19801# Army Foreign Science and Technology Center, Washington, D.C.

SOME PROBLEMS OF DEVELOPING MEMORY UNITS FOR DIGITAL COMPUTERS [O NEKOTORYKH PROBLEMAKH LAZRABOTKI ZAPOMINAYUSHCHIKH USTROISTV TSIFORVYKH VYCHISLITELNYKH MASHIN]

L. P. Kraizmer et al 2 Sep. 1970 173 p refs Transl. into ENGLISH from the book "Zapominayushchie Ustroistya" Leningrad, Energiya, 1968 p 1-168

(AD-716674; FSTC-HT-23-628-70) Avail: NTIS CSCL 9/2

The rapid development of cybernetic technology involves a continual increase in the exacting requirements for the memory units in computers, controllers, information-logic devices and other cybernetic equipment. These requirements reduce basically to an increase in capacity, speed, economy and reliability, as well as a reduction in the overall size of the memory devices. In connection with improving computers, the following are discussed: problems of developing memory units for digital computers, logical principles for organizing the complex of memory devices in digital computers and systems, automatic information exchange between auxiliary and working memory devices, an associative electronic memory, permanent memory devices, reliability of memory devices, memory control circuits, selecting magnetic cores for memory devices, magnetic storage elements with nondestructive readout (classification principles and criteria for comparative evaluation), on analysis of magnetic connections in storage elements with nondestructive data readout, and on the problem of criteria for evaluating memory devices. Author (GRA)

N71-19923*# California Univ., Santa Cruz.

DESIGNING A COMPUTER: THE ECLECTIC INFORMATION PROCESSING SYSTEM. THE COMPUTER EVOLUTION PROJECT (CEP) REPORT, VOLUME 4, NO. 1

James H. Haynes Jan. 1971 79 p refs

(Grants NGR-05-061-005; NSF GJ-150)

(NASA-CR-117304) Avail: NTIS CSCL 09B

The development of an eclectic information processing system in designing a computer is described. A twofold approach is followed: (1) software should be written in conceptually powerful high-level language and (2) machines should be designed to execute programs written in the languages to be used. Author

N71-19986# Stanford Univ., Calif. Computer Science Dept.

GRAPH PROGRAM SIMULATION

Ed Nelson [1970] 188 p Sponsored by AEC

(TID-25593) Avail: NTIS

A simulator is described which interprets Adams's graph programs, carrying out the computations specified by a set of graph procedures and keeping statistics on the timing and resource usage. Experiments performed with the simulator are also described. Simulations were run on a number of small programs, including a matrix multiply program, a quadrature program, and a sort program. The programs were run using varying amounts of data, various speeds for the primitive operations, allowing or not allowing multiple instances of a p-node to execute simultaneously. The simulations were run using the unrealistic assumption that the machine specified by the simulator had an unlimited number of processors to carry out the operations specified by the primitive nodes and an unlimited amount of money. These simulations were run in an attempt to discover the inherent resource usage characteristic of the programs and the effect of varying the relative speed of primitive operations independently of effects due to different algorithms for allocating processors in an environment with a finite number of processors. These effects can then be controlled during simulations run in the more realistic environment of a finite machine Author

N71-20068# Stanford Linear Accelerator Center, Calif.

DIRECT EMULATION OF CONTROL STRUCTURES BY A PARALLEL MICROCOMPUTER

Victor R. Lesser Oct. 1970 64 p refs Sponsored in part by NSF

(Contract AT(04-3)-515)

(SLAC-127) Avail: NTIS

The organization of a parallel microcomputer designed to emulate a wide variety of sequential and parallel computers was investigated. This microcomputer allows tailoring of the control structure of an emulator so that it directly emulates (mirrors) the control structure of the computer to be emulated. An emulated control structure is implemented through a tree type data structure which is dynamically generated and manipulated by six primitive (built-in) operators. The major features of the control data structure and the primitive operators are: (1) once the fixed control and data linkages among processes have been defined, they need not be rebuilt on subsequent executions of the control structure; (2) microprograms may be written so that they execute independently of the number of physical processors present and still take advantage of available processors; (3) control structures for I/O processes, data-accessing processes, and computational processes are expressed in a single uniform framework. Author

N71-20110# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

HYBRID SOFTWARE SYSTEM LIBRARY AND MACROS

L. H. Gerhardstein 21 Oct. 1970 102 p

(Contract AT(45-1)-1830)

(BNWL-B-26) Avail: NTIS

Descriptions are given of library routines and macros for the hybrid systems: (1) BNW, Hybrid No. 1, PDP-7; (2) BNW, Hydrology Data Display System, PDP-9; and (3) WADCO, PDP-9 Hybrid. The execution times given are for PDP-9 and cannot be converted directly to PDP-7 or 15 execution times. In general, execution times do not include optional set-up instructions. The programs exist in the PDP-7/9/15 advanced software systems and require the presence of an API. Macro definitions apply only to the HYMAC assembler. Author

N71-20120*# Indiana Univ., Bloomington. Aerospace Research Applications Center.

INFORMATION RESOURCES AND SERVICES OF THE NASA REGIONAL DISSEMINATION CENTERS

1 Feb. 1971 40 p refs

(Contract NSR-15-003-076)

(NASA-CR-117175) Avail: NTIS CSCL 05B

The NASA Regional Dissemination Centers (RDC) have reached a state of maturity where a variety of technical information files, resources, and services are now available. The six RDC's have formed and informal association and network in recent years known as ACORDD. One outgrowth of ACORDD was a pooling or sharing of resources such that an information center network exists whereby the resources available to any one RDC are available to the entire network. The nature of the resources and services available through the NASA RDC network is described. Author

N71-20124# Brookhaven National Lab., Upton, N.Y.

ASSOCIATIVE CAPABILITIES FOR MASS STORAGE THROUGH ARRAY ORGANIZATION

Arnold M. Peskin 16 Mar. 1970 16 p refs Sponsored by AEC (BNL-14519) Avail: NTIS

An associative memory system has been designed which exhibits excellent cost performance characteristics by taking advantage of recent developments in integrated circuit technology and a unique method of organization and interaction between conventional and content addressable storage arrays. A large conventional memory matrix is connected adjacent to the small content addressable array. The organization of information and interactivity of matrices is specified so that, for many important applications, the larger conventional storage itself virtually exhibits the property of content addressability. A discussion is presented on the implementation of this scheme for file scanning operations at Brookhaven National Laboratory utilizing the Brooknet digital communications network. Author

N71-20133# Advisory Group for Aerospace Research and Development, Paris (France).

SEQUENCE OF LINEAR PROGRAMS

G. G. Pope *In its* Structural Design Appl. of Mathematical Programming Tech. Feb. 1971 p 48–54 refs (See N71-20128 09-32)

Copyright. Avail: NTIS

The reduction of nonlinear programming problems to a sequence of linear programming problems is discussed. Important properties of linear programming problems and methods of their solution are described. In nonlinear programming, problems considered first are those in which all constraints are expressed as inequalities and in which only two variables are involved. Methods of reducing the nonlinear problems are outlined: The simplest approach linearizes the constraints and merit function in the neighborhood of an arbitrary point; The cutting plane method employs the property that linearized constraints in convex problems necessarily lie entirely outside the feasible region; The move limit method makes use of artificial limits on the variation of the design variables in a typical linearized computation. In all of these methods, the coefficients of the design variables in the objective function of the primal problem are nearly always all positive. N.E.N.

N71-20136# Advisory Group for Aerospace Research and Development, Paris (France).

COMPUTER PROGRAMS FOR THE OPTIMUM DESIGN OF COMPLEX ELASTIC STRUCTURES

G. G. Pope *In its* Structural Design Appl. of Mathematical Programming Tech. Feb. 1971 p 96–101 refs (See N71-20128 09-32)

Copyright. Avail: NTIS

Computer programs developed for the optimum design of idealized aerospace structures of arbitrary geometry, including optimization algorithms and segments for finite element analysis, are described. These programs are concerned mainly with the choice of member cross-sectional areas and thicknesses, but some include facilities which permit the lengths and spacings of members to be varied within a prescribed topology. Rigorous optimization procedures are emphasized. Computer programs developed to apply mathematical programming techniques to the least weight design of complex stress-skin structures and major subsequent contribution are discussed. Application of iterative procedures for the generation of fully-stressed designs is also described. Author

N71-20180# Douglas Aircraft Co., Inc., Long Beach, Calif.

FORMAT-FORTRAN MATRIX ABSTRACTION TECHNIQUE. VOLUME 2: DESCRIPTION OF DIGITAL COMPUTER PROGRAM, EXTENDED, SUPPLEMENT 3 Final Report, 1 Jul. 1968–30 Apr. 1970

W. J. Lackey and S. H. Miyawaki Wright-Patterson AFB, Ohio AFFDL Aug. 1970 161 p refs

(Contract F33615-68-C-1633)

(AD-715982; DAC-33569-Vol-2-Suppl-3; AFFDL-TR-66-207-Vol-2-Suppl-3) Avail: NTIS CSCL 20/11

The FORMAT System has been updated by the incorporation of additional basic capability and the refinement of existing capability. A simpler mode of updating case data and extended force method matrix generation capability has been incorporated in Phase I of the system. A refined Structure Cutter module, capabilities for matrix partitioning and instruction looping, and an additional eigenvalue/eigenvector extraction module have been incorporated in Phase II. Finally the limitations which existed in the matrix plotting capability in Phase III have been eliminated. Programming documentation for the extended capability of Phase II of the FORMAT System is presented in the report. Author (GRA)

N71-20280*# Systems Associates, Long Beach, Calif.

COMPUTER PROGRAM DOCUMENTATION: SYSTID, SYSTEM TIME-DOMAIN SIMULATION PROGRAM

Ernest Freeman and Michael Fashano Feb. 1971 144 p

(Contract NAS9-10831)

(NASA-CR-114914; R71-014) Avail: NTIS CSCL 09B

The SYSTID computer program allowing the user to achieve time domain simulations of telecommunications links, such as the Apollo links is discussed. The program is written in FORTRAN 5, and is operational on the NASA/MSC Univac 1108 system. The SYSTID program was designed such that the input data set required of the user is minimal. This program characteristic is achieved through use of a language processor which translates simple English-language user commands and link element descriptions and topology into the FORTRAN code necessary to establish a digital filter equivalent of each link. The program's time domain simulation technique employs the bilinear z-transform, to reduce run time, and minimize the errors commonly associated with sampled data representations. In addition, a model library was implemented so that commonly encountered telecommunications link elements can be called up by the user directly, without detailed user coding. These library models include link elements such as modulators, demodulators, filters, limiters, and other elements. Author

N71-20332*# Stanford Univ., Calif. Digital Systems Lab.

PARALLEL IMPLEMENTATION OF A SINGLE ASSIGNMENT LANGUAGE

D. D. Chamberlin (Ph.D. Thesis) Jan. 1971 181 p refs

(Grant NGR-05-020-337; Contract N00014-67-A-0112-0044)

(NASA-CR-117174; SU-SEL-71-007; TR-13) Avail: NTIS CSCL 09B

A high level computer programming language, called SAMPLE, and a parallel processing system to implement the language are described. In this class of single assignment languages statements are not necessarily executed in their order of appearance in the program; rather, each statement is triggered by the readiness of the data on which it depends. Rules are given for compiling SAMPLE programs into machine level instructions, and a machine organization is described to execute the resulting code. During execution of a program, many processors are active simultaneously, each with its own independent instruction stream. It is concluded that the proposed system offers a speed advantage over a conventional system, at the expense of increased processor costs and memory requirements. Author

N71-20424# RAND Corp., Santa Monica, Calif.

THE COMPLEAT MT/ST OPERATOR

Liz Cameron and Phyllis Davidson Apr. 1970 66 p

(AD-705259; P-4353) Copyright. Avail: NTIS

An operator's manual is presented for IBM's Magnetic Tape/Selectric Typewriter MT/ST combination. Included are: comprehensive discussions of the action of the machine in each of its various 'modes'; a detailed description of the controls; definitions of terms needed by an operator; suggestions and advice on

necessary record keeping; a trouble-shooting section answering the question "What did I do wrong"; and specific operating instructions for both the Mod II and the Mod IV versions of the machine, including detailed instructions for the technical typist.
Author (GRA)

N71-20671* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DISPLAY FOR BINARY CHARACTERS Patent
John R. Cressey and Charles E. Cote, inventors (to NASA) Issued 8 Apr. 1969 (Filed 28 Feb. 1967) 6 p Cl. 315-24; Int. Cl. H01j29/70
(NASA-Case-XGS-04987; US-Patent-3,437,874; US-Patent-Appl-SN-619908) Avail: US Patent Office CSCL 09B

Disclosed is a CRT system for displaying ones and zeros in a binary wave train. The CRT beam is discretely stepped to a plurality of horizontal and vertical discrete locations with stair step generators. At each location a one or zero is written utilizing Lissajous pattern techniques. If the binary signal being monitored is a zero, orthogonal sinusoidal voltages are applied to a particular discrete location on the CRT face while a binary one signal causes only one of the sinusoids to be applied to the CRT.
Official Gazette of the U.S. Patent Office

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N71-19395# Radio Corp. of America, Harrison, N.J.
SILICON GERMANIUM THERMOELECTRIC MATERIALS AND MODULE DEVELOPMENT PROGRAM Quarterly Report, 1 Apr. –30 Jun. 1970
Jun. 1970 78 p
(Contract AT(29-2)-2510)
(ALO-(2510)-10; QR-10) Avail: NTIS

Research and development are reported on SiGe thermoelectric materials technology, air-vac module development, and cascaded converter development. The 24 thermocouple test panel P-1 (24A) was fabricated, assembled, and instrumented for performance testing. Fabrication of the foil insulation for panel CA-3 was also completed, and fabrication of the thermocouples was initiated. The performance of shock and vibration testing of the zirconia felt-insulated 5-watt converter (C3Z) was continued with no change in operating characteristics noted as a result of these tests. A rerun of performance mapping on the rebuilt C-4 converter was conducted with essentially the same B.O.L. performance noted as in the earlier run. An excess of 2100 hours of stability testing at 1100 C was accumulated on the C-4 converter with no degradation attributable to leakage resistance in the thermopile. The accumulation of substantial additional thermal conductivity data is reported on SiMo and SiGe over a range of compositions.
Author (NSA)

N71-19429# Maryland Univ., College Park. Dept. of Electrical Engineering.
GENERATION OF ALL FINITE LINEAR CIRCUITS USING THE INTEGRATED DVCCS
R. W. Newcomb and M. Bialko (Stanford Electronics Labs.) Nov. 1970 12 p refs
(Contract F44620-67-C-0001; Grants AF-AFOSR-1910-70; NSF GK-16240)
(AD-716583; AFOSR-70-2743TR) Avail: NTIS CSCL 9/5

In conjunction with the capacitor, the differential voltage controlled current source DVCCS is shown to contain all components needed for linear circuit construction in an integrated form. The effects of dissipative losses in the DVCCS are tabulated for several configurations. Finally, a new building block having two outputs is introduced.
Author (GRA)

N71-19448* Melpar, Inc., Falls Church, Va.
TELEVISION SIMULATION FOR AIRCRAFT AND SPACE FLIGHT Patent
John E. Conant, inventor (to NASA) Issued 29 Jul. 1969 (Filed 10 Nov. 1965) 9 p Cl. 178-6; Int. Cl. H04n7/00, 3/16, 5/38
Sponsored by NASA
(NASA-Case-XFR-03107; US-Patent-3,458,651; US-Patent-Appl-SN-507257) Avail: US Patent Office CSCL 17B

A wide angle image transmission and projection system, in which a single camera is used in cooperation with a single projection unit to provide a wide angle image on a projection screen is described. The latter is fixedly positioned with respect to the projection unit which includes optics to control the relative position of the projected image on the fixed screen so as to simulate roll, pitch, and azimuth angle of the projected image with respect to a fixed optical axis. The center of the projection surface is aligned to the optical axis.
Official Gazette of the U.S. Patent Office

N71-19466* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STABLE AMPLIFIER HAVING A STABLE QUIESCENT POINT Patent
Leonard L. Kleinberg, inventor (to NASA) Issued 9 Sep. 1969 (Filed 22 Oct. 1965) 5 p Cl. 330-30; Int. Cl. H03f3/68
(NASA-Case-XGS-02812; US-Patent-3,466,560; US-Patent-Appl-SN-502750) Avail: US Patent Office CSCL 09E

An electronic amplifier using a feedback system providing both stability and high gain which is adaptable for monolithic and thin film construction is described. The quiescent point of the amplifier circuit is maintained at a constant voltage level through the use of feedback from a differential amplifier which amplifies the direct current difference between the amplifier output and a stable reference.
Official Gazette of the U.S. Patent Office

N71-19470* Honeywell, Inc., Minneapolis, Minn.
STATIC INVERTER Patent
John T. Lingle, inventor (to NASA) Issued 30 Sep. 1969 (Filed 19 Apr. 1967) 9 p Cl. 331-113; Int. Cl. H03k3/28, 3/30
Sponsored by NASA
(NASA-Case-XGS-05289; US-Patent-3,470,496; US-Patent-Appl-SN-632104) Avail: US Patent Office CSCL 09E

An oscillating static inverter packaged to minimize external magnetic fields is described. The inverter comprises transistors positioned at opposite ends of an outer conducting tube coaxial with a center conductor. The tube and conductor supply current from a direct current source at one end of the tube during one half cycle of oscillation. A second outer tube and center conductor feed current in opposite directions to the transistors at the first end of the tube during the other half of the cycle. The two center conductors are center tapped windings of coupling and power transformers of the oscillator.
Official Gazette of the U.S. Patent Office

N71-19479* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
LIGHT INTENSITY MODULATOR CONTROLLER Patent
Herbert K. Strass and Hoyt E. Maples, inventors (to NASA) Issued 11 Feb. 1969 (Filed 23 Dec. 1965) 8 p Cl. 350-275; Int. Cl. G02f1/30
(NASA-Case-XMS-04300; US-Patent-3,427,093; US-Patent-Appl-SN-516158) Avail: US Patent Office CSCL 09E

A device is described for modulating and controlling the intensity of light beams from high temperature sources. The modulator consists of two or more grooved-hollow rotating-circular cylinders with the surfaces in contact. The grooves provide apertures for modulating and controlling the beam. The rotation of the cylinders is regulated by a servo using a sensor which generates a current proportional to the intensity of the incident beam. F.O.S.

N71-19480* Beckman Instruments, Inc., Fullerton, Calif.
ELECTRONIC DIVIDER AND MULTIPLIER USING PHOTOCELLS Patent
Anthony del Duca, inventor (to NASA) Issued 21 Jan. 1969 (Filed 3 Sep. 1965) 4 p Cl. 235-194; Int. Cl. G06g7/16 Sponsored by NASA
(NASA-Case-XFR-05637; US-Patent-3,423,579; US-Patent-Appl-SN-484855) Avail: US Patent Office CSCL 09A

An electronic divider and multiplier for analog electric signals consisting of two voltage dividing networks is described. Each circuit is comprised of a photoconductor in series with a resistor. A light emitter is connected to the differential output of the networks, and optically coupled to both photoconductors. The circuit is capable of performing both multiplication and division with a time constant of a few milliseconds which is determined by the response of the feedback path of the light emitter. F.O.S.

N71-19481 Yale Univ., New Haven, Conn.
PROPERTIES OF MAGNETIC INSULATORS AT RADIO FREQUENCIES
Richmond Bennett Clover, Jr. (Ph.D. Thesis) 1969 231 p
Avail: Univ. Microfilms: HC $10.60/Microfilm $3.00 Order No. 70-2710

A new tunnel diode oscillator is described which is used to carry out ac paramagnetic susceptibility experiments at radiofrequencies. The longitudinal susceptibility of several rare earth insulators is measured at frequencies from 3.4 to 55 MHz, at temperatures from 1 to 77 K and magnetic fields up to 18kG. The magnetic specific heat is calculated from the measured susceptibilities and for each compound, the size of nearest and next-nearest neighbor magnetic interactions are estimated. For the compound cerium ethyl sulfate, the measured susceptibilities provide information about an anomalously fast spin-lattice relaxation process for the Ce(3+) ions. For neodymium ethyl sulfate, the field dependence of the susceptibility reveals an unusual effect on spinkspin relaxation processes due to the existence of electron-nuclear hyperfine interactions in twenty percent of the Nd(3+) ions. Dissert. Abstr.

N71-19516* Hughes Aircraft Co., Los Angeles, Calif.
HIGH VOLTAGE TRANSISTOR CIRCUIT Patent
James S. Lee, inventor (to NASA) Issued 17 Mar. 1970 (Filed 17 May 1967) 5 p Cl. 330-30; Int. Cl. H03f3/68 Sponsored by NASA Prepared for JPL
(NASA-Case-XNP-6937; US-Patent-3,501,712; US-Patent-Appl-SN-640449) Avail: US Patent Office CSCL 09A

A transistor amplifier which has two series-connected transistor subcircuits for sharing the output voltage and thus enabling higher voltage operation is described. One subcircuit is of the Darlington type and the other is a complementary pair which eliminates a base-emitter in the feedback path. The amplifier provides a high input impedance, low output impedance, and low power dissipation. Official Gazette of the U.S. Patent Office

N71-19561# Michigan Univ., Ann Arbor. Dept. of Electrical Engineering.
THE OPTIMIZATION OF NUMERICAL MODELS OF SEMICONDUCTOR DEVICES
L. C. McAffee, Jr. (Ph.D. Thesis) Nov. 1970 12 p refs
(Grant AF-AFOSR-1217-67)
(AD-716539; AFOSR-70-2736TR) Avail: NTIS CSCL 9/1

For semiconductor devices analytic solutions to the set of describing nonlinear partial differential equations do not in general exist. Lumped electrical models and digital computer numerical models have been used to obtain approximate solutions. The research which in part is being reported was concerned with methods for systematically and efficiently finding small and accurate numerical models suitable for use in algorithms for computer-aided analysis and design of bipolar junction devices. Author (GRA)

N71-19567# Army Electronics Command, Fort Monmouth, N.J.
A NEW APPROACH TO A HIGH-STABILITY TEMPERATURE-COMPENSATED CRYSTAL OSCILLATOR
S. Schodowski Nov. 1970 33 p ref
(AD-715955; ECOM-3359) Avail: NTIS CSCL 9/5

The report describes a compensation approach based on the introduction of controlled nonlinearity into the TCXOs frequency-voltage tuning characteristic by using a pair of varactor diodes and a fixed bias source. The result is considerable simplification of the temperature-compensation process for a TCXO using a fundamental AT-cut crystal unit. The simplification comes about by transformation of portion of the classic cubic voltage correction function to a monotonic function which then can be approximated to a high degree of accuracy with one or two 3-point network segments, using a given thermistor in each. A stability of plus or minus 5 x 10 to the minus 8th power (5 to 80C) was obtained in one case where the required monotonic compensation function was generated in two segments. In another example, a stability of plus or minus 1 x 10 to the minus 8th power was easily obtained by compensating over a plus or minus 10C range about the upper turnover temperature. Author (GRA)

N71-19577# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CAPACITORS [KONDENSATORY]
I. V. Mikhailov et al 21 Oct. 1970 49 p Transl. into ENGLISH from Massovaya Radio Biblioteka (USSR), no. 573, 1965 p 1-32
(AD-716522; FTD-MT-24-155-70) Avail: NTIS CSCL 9/1

The publication provides a detailed description of a variety of capacitors, giving their voltage and capacitance ratings, and lists the purposes for which they are designed and manufactured. It also provides detailed instructions on how to mount the various capacitors to the chassis of different electronic equipment. Author (GRA)

N71-19610* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELECTRICAL SWITCHING DEVICE Patent
Charles W. Edman, inventor (to NASA) Issued 30 Sep. 1969 (Filed 26 Jan. 1968) 6 p Cl. 200-152; Int. Cl. H01h29/00, 35/02, 29/02 Sponsored by NASA
(NASA-Case, NPO-10037; US-Patent-3,470,342; US-Patent-Appl-SN-700987) Avail: US Patent Office CSCL 09A

An electrically conductive liquid is confined within a square loop of deformable nonconductive tubing having electrical terminals on two opposite corners connected to the opposite poles of a battery, and terminals at the other two corners connected to an output circuit. Simultaneously displacing the liquid in one pair of opposite sides of the loop energizes the circuit with a given polarity. Reversing the situation by displacing the liquid in the other pair, reverses the polarity. The device is also usable as a leveling switch by forming a ridge in each nonconductive side equal in height to the level of the conductive liquid when the device is horizontally level. When not level, two adjacent corners are electrically connected to actuate a leveling device. Official Gazette of the U.S. Patent Office

N71-19624# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME QUESTIONS IN THE THEORY OF AUTO

COLLECTOR MODULATION (AKM) AND AMPLITUDE-FREQUENCY DISTORTION IN AKM
Yu. I. Sudakov 29 Oct. 1970 23 p refs Transl. into ENGLISH from the publ. 'Radiotekhnika. Elektronnyye Priobory Svch. Amedlyayushchiye Sistemy i Nekotoryye Voprosy Teorii Plazmy' Kharkov, Inst. Radioelektron., 1966 p 140–150
(AD-716529; FTD-HC-23-1442-68) Avail: NTIS CSCL 9/5

In his previous works, Yu. I. Sudakov has shown the possibility of the base or collector amplitude modulation in externally excited transistorized oscillators connected in a common emitter configuration. Base modulation requires a low power modulator which provides low efficiency (35-40 percent), while collector modulation (with 70-80 percent efficiency) requires a more powerful modulator. The disadvantages of both modulation types are manifested sharply if they are designed for the output stages of transistorized transmitters. The author has proven that collector self-modulation (CSM) in the output stage with a common emitter combines the positive properties of base and collector types of modulation. The present article is devoted to an analysis of an equivalent circuit of a stage with the low-frequency CSM. One of the most simple CSMs is a circuit in which the self-bias has been introduced. To verify the fundamental theoretical conclusions reached in the analysis presented, an experimental test circuit was designed. Measurements of CMS frequency-amplitude distortions in the transmitter output stage were carried out at a frequency of 3mHz. The modulation frequency was varied from 100 to 10,000 to 128,000 Hz. The induction of the inductor was changed with the aid of a switch.
Author (GRA)

N71-19625# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH POWER ELECTRONICS (COLLECTION OF ARTICLES)
L. A. Vainshtein et al 26 Oct. 1970 245 p refs Transl. into ENGLISH from Elektron. Bolshikh Moshch. (USSR), v. 3, 1964 p 1–215 and 231–243
(AD-716513; FTD-HC-23-261-70) Avail: NTIS CSCL 9/5

The collection presents articles devoted to the theory of continuous oscillators of the magnetron type which are distinguished by the fact that in the slits connecting the working space with the cavity resonator the electric field oscillates in phase (0-oscillation), whereas in ordinary magnetrons the electric field in adjacent slits oscillates in opposite phase. In our first collection a description was given of planotrons - oscillators with a plane- parallel working space in which a 0-oscillation is excited. If one changes to a cylindrical working space, then one can connect it (by means of a large number of slits) with a single resonator having a high quality factor. This is very important for the production of continuous operation power oscillators. The collection concludes with two papers in which coupled oscillations in cavity resonators are investigated. The problems to which the papers are devoted also arose in the course of our work on high-power electronics. Author (GRA)

N71-19755# Colorado Univ., Boulder. Dept. of Electrical Engineering.
NONLINEAR ELECTRICAL GENERATOR STUDY Final Report
Edward Alexander Erdely, and Ewald F. Fuchs Oct. 1970 127 p refs
(Contract N00014-67-A-0405-0003)
(AD-716437) Avail: NTIS CSCL 10/2

Improvements in the method of determining by numerical methods the magnetic fields of nonlinear dc generators used by the Navy are finalized in a comprehensive computer program. A modified, successive line overrelaxation numerical method is explained; a novel block acceleration of convergence is introduced. Position changes between armature and field are considered as preparation for commutation studies. The procedure is applied to find the performance of a 500 hp, 750V, 4-pole, 300/900 rpm dc machine. The convergence of the relaxation procedure is studied and suitable overrelaxation factors experimentally established. A separate computer program controls a Calcomp X-Y plotter to represent the results with the aid of equi-potential field lines.
Author (GRA)

N71-19756# Minnesota Univ., Minneapolis. Inst. of Technology.
STUDY OF NOISE IN SPACE CHARGE LIMITED SOLID STATE DEVICES Final Report, 23 Oct. 1964–15 Jun. 1970
A. Van Der Ziel Dec. 1970 23 p refs
(Contract DA-31-124-ARO(D)-291)
(AD-716579; AROD-5117-26-E) Avail: NTIS CSCL 9/1

The report presents the results of a study of the high-frequency noise in space-charge-limited solid-state devices, and the measurements of the static characteristic and of the admittance of the device were used to help in the interpretation of the noise data.
Author (GRA)

N71-19757# Rome Air Development Center, Griffiss AFB, N.Y.
STRESS INDUCED INTERMITTENT FAILURES IN ENCAPSULATED MICROCIRCUITS
John R. Haberer Oct. 1970 59 p refs
(AD-715984; RADC-TR-70-213) Avail: NTIS CSCL 9/5

The problem of temperature intermittent operation in encapsulated integrated circuit is discussed and a technique is presented which has been effective in detecting potential failures resulting from metallization, bond or lead wire temperature intermittents. These are the main causes of intermittent operation in encapsulated microcircuits at present, and this technique should lead to improvement in encapsulated device reliability if implemented as a screening or qualification test. The instrumentation used at RADC for this technique, called the Monitored Thermal Cycle Test (MTC), is presented and a proposed standard test method, based on this test is included as an Appendix. Several representative device failure analysis summaries are included to illustrate the cause of typical encapsulated integrated circuit intermittents resulting from failure of the lead wire-bond-interconnect system.
Author (GRA)

N71-19777*# Martin Marietta Corp., Denver, Colo.
SOLID STATE SEQUENCER SYSTEM, PHASE 2. APPENDIX C: RELIABILITY ANALYSIS, VOLUME 4 Summary Report
Mar. 1971 40 p
(Contract NAS9-9334)
(NASA-CR-114909; MCR-71-55-Vol-4-App-C) Avail: NTIS CSCL 09E

Reliability prediction, failure modes and effects analysis for the engineering model sequencer demonstrate the reliability requirements. Appropriate assumptions are made regarding total mission time, checkout time, dormant time, and the various modes of system operation during these various phases of the total mission.
Author

N71-19848# R. F. Communications, Inc., Rochester, N.Y.
THE AN/URA-38 MODIFICATION KIT TO ELIMINATE THE SUSCEPTIBILITY OF NEAR FIELD ANTENNA INTERFERENCE Final Report, 7 Nov. 1969–31 Jul. 1970
Richard A. Kircher 12 Oct. 1970 50 p
(Contract N00123-70-C-0838)
(AD-716475; RFC-9961) Avail: NTIS CSCL 9/5

The report presents the development work and resulting prototype AN/URA-38 antenna coupler modification kit built by R F Communications under Contract No. N0123-70-C-0838. The kit includes a frequency selective discriminator that provides coupler phasing and resistance information over the 2-30 MHz range. The selectivity feature is intended to eliminate antenna coupler mistuning by reducing the susceptibility to near-field adjacent channel antenna interference. The development programs objective to improve or allow communications under severe radio interference was achieved.
Author (GRA)

N71-19875*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
CABLING AND CONNECTORS FOR USE ON A NUCLEAR STAGE Final Report
G. I. Abrams 23 Feb. 1971 178 p refs
(Contract NAS8-25620)
(NASA-CR-103056; MDC-G0757) Avail: NTIS CSCL 09A

The cable and connector data relevant to a reusable nuclear shuttle are detailed and appropriate recommendations are made. The environmental and functional requirements are defined, and radiation effects on organic and inorganic materials are presented. Attractive insulation materials and fabrication techniques for the steady-state radiation environment are coupled with candidate system concepts including flat, round, and ribbon cable approaches. Aluminum, permanent, connectorless, and conventional terminations are considered. Recommendations include the use of copper conductors, all-polyimide insulation, small gage, flat conductor cable for major wire bundles, conventional round wire for power and short point-to-point installations, and extensive use of permanent and connectorless terminations to enhance reliability. Author

N71-19906# Rensselaer Research Corp., Troy, N.Y. Electronic Systems Dept.
BULK SEMICONDUCTOR LIMITERS Quarterly Progress Report, 1 May –31 Jul. 1970
A. L. Armstrong, J. N. Park, P. E. Bakeman, W. C. Taft, and E. S. Staiger Ft. Monmouth, N.J. ECOM Dec. 1970 37 p refs
(Contract DAAB07-70-C-0195)
(AD-716626; ECOM-0195-1; QPR-1) Avail: NTIS CSCL 9/1

The feasibility and significant advantages of the bulk semiconductor approach for the provision of microwave limiter components have been demonstrated by previous research programs. This past work has shown that impact ionization can be utilized in suitable semiconductor structures to provide larger bandwidth and power handling capability than obtainable with conventional semiconductor diodes at both X and Ku-band frequencies. The theoretical model that was developed for the microwave limiting phenomeon also predicts useful limiting at frequencies above Ku-band. The microwave mounting structure that was analyzed and found well suited for the semiconductor limiting element was the resonant slit iris with the element situated in the center of the iris. This structure provided the features of enhanced electric field to produce limiting at lower RF power levels, resonable bandwidth, ease of tuning, and good heat removal. The present program extends and applies this knowledge toward upgrading component performance. During the first quarter, effort was directed toward improving the fabrication and mounting techniques. In addition, test results are given of components using identical elements in single element X-band irises and both single and double element Ku-band irises. A thermal analysis of the limiter structure is presented which aids in predicting the power capability of new designs. For example, the instantaneous peak temperature of the end of a 10 kW, 1 microsec pulse is found to be 260C for a relatively small 3 mil thick element with a 5 mil diameter contact. Author (GRA)

N71-19943# Ministry of Aviation Supply, London (England).
SUMMARY OF ELECTRONIC COMPONENT R AND D PROGRAMME
Dec. 1970 39 p
Avail: NTIS

Details of research and development projects concerning passive electronic components, materials, and associated techniques are summarized including resistors, capacitors, microwave components, electromechanical devices, quartz crystals, and assembly techniques. J.M.

N71-20084# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
TUNNEL DIODE AMPLIFIERS AND THEIR BACKGROUND NOISE AS A FUNCTION OF THE POLARIZATION POINT, THE TEMPERATURE, AND THE BANDWIDTH [AMPLIFICATEURS A DIODE TUNNEL ET LEUR BRUIT DE FOND, EN FONCTION DU POINT DE POLARISATION, DE LA TEMPERATURE ET DE LA BANDE PASSANTE]
Kazem Ozveaminian (Ph.D. Thesis) Jun. 1969 145 p refs In FRENCH
(CEA-R-3709) Avail: AEC Depository Libraries

Mathematical and graphical methods for the study of the stability of tunnel diode circuits are presented, and applications to the realization of three amplifiers are given. A theoretical and experimental investigation is described of the noise of these amplifiers and of variations with the bias, the temperature, and the bandwidth. Author (NSA)

N71-20228# National Bureau of Standards, Washington, D.C.
MEASUREMENT METHODS FOR MICROCIRCUITS
W. Murray Bullis *In its* Space Simulation Oct. 1970 p 449–455 refs (See N71-20201 09-11)
Avail: SOD $5.25

Simulated or real environmental testing is associated with the necessity of demonstrating that the failures observed are, in fact, due to the environment rather than random effects which occur even in the absence of the environmental stimulus. This problem is particularly acute in the case of high-reliability electronic components such as silicon monolithic integrated circuits. For these parts, desired levels of reliability can be achieved only if all process steps in their manufacture can be carried out in a controlled and reproducible fashion. Consideration is given to standard measurement methods appropriate for thin film integrated circuits and hybrid microcircuits as well as those for silicon monolithic integrated circuits fabricated by the epitaxial, planar process. Author

N71-20331*# Martin Marietta Corp., Denver, Colo.
AUTOMATIC TEST EQUIPMENT FOR ELECTRONIC COMPONENTS, VOLUME 2 Final Technical Report
William A. Heffner Washington NASA Mar. 1971 145 p
(Contract NAS12-2045)
(NASA-CR-1755; MCR-69-520-VOL-2) Avail: NTIS CSCL 09E

An automatic test facility for testing discrete and integrated electronic components is described. The analysis of requirements, candidate configurations, specifications of the selected configurations, a cost effectiveness study, and acquisition plans are covered. The primary focus is on technology changes and future trends. Author

N71-20445* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRANSMISSION LINE THERMAL SHORT Patent
Robert C. Clauss, inventor (to NASA) Issued 21 Oct. 1969 (Filed 15 Sep. 1967) 7 p Cl. 333-96; Int. Cl. H01p3/06 Sponsored by NASA
(NASA-Case-XNP-09775; US-Patent-3,474,357; US-Patent-Appl-SN-668247) Avail: US Patent Office CSCL 09E

A device for cooling the center or inner conductor of a coaxial cable by conducting heat between the outer and center conductors without changing the electrical characteristics is described. The device consists of bars or wires extending a quarter wavelength along the cable with one end fixed to the center conductor and the other end in contact with the outer conductor. Official Gazette of the U.S. Patent Office

N71-20448* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GENERATOR FOR A SPACE POWER SYSTEM Patent
Dale W. Cooper and Perry W. Kuhns, inventors (to NASA) Issued 27 May 1969 (Filed 2 Mar. 1967) 4 p Cl. 310-54; Int. Cl. H02k9/19
(NASA-Case-XLE-04250; US-Patent-3,447,003;

US-Patent-Appl-SN-621098) Avail: US Patent Office CSCL 09E

A space power generating system having a rotor in the form of a slotted armature of electrically insulating material is described. Each slot is filled with small diameter copper wires. Rotation of the armature moves these wires through the field of a fixed superconducting magnet which forms the stator. The device differs from the usual alternator in that the stator is the field while the rotor is the armature.

Official Gazette of the U.S. Patent Office

N71-20447* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

VARIABLE PULSE WIDTH MULTIPLIER Patent

Nelson J. Groom, inventor (to NASA) Issued 14 Oct. 1969 (Filed 10 Jun. 1966) 4 p Cl. 307-267; Int. Cl. H03k1/18 (NASA-Case-XLA-02850; US-Patent-3,473,050; US-Patent-Appl-SN-556784) Avail: US Patent Office CSCL 09E

A device for producing an output pulse whose duration is proportional to the duration of an input pulse is described. Means are provided for linearly discharging a fully charged capacitor throughout the duration of the input pulse. The capacitor then recharges to its fully charged state. The capacitor produces a pulse when discharge begins and ends when the capacitor is fully recharged. A method is provided for changing the discharge and recharge rates of the capacitor.

Official Gazette of the U.S. Patent Office

N71-20569* Honeywell, Inc., Minneapolis, Minn.

HIGH IMPEDANCE MEASURING APPARATUS Patent

Michael M. E. Van Schoiack, inventor (to NASA) Issued 18 Mar. 1969 (Filed 25 Apr. 1966) 5 p Cl. 324-57; Int. Cl. G01r27/08; Int. Cl. G05f1/40, 1/60 Sponsored by NASA Prepared in cooperation with North Am. Aviation, Inc., El Segundo, Calif. (NASA-Case-XMS-08589-1; US-Patent-3,434,050; US-Patent-Appl-SN-544899) Avail: US Patent Office CSCL 09E

An apparatus for measuring high electrical impedance is described. The device consists of a power supply which supplies an output current to a load impedance. The current through the load is conducted through a sensor to create a voltage which is measured to indicate load impedance. The sensing means also provides a signal which is compared with a reference signal. The comparison produces an error control signal corresponding to the difference between the apparatus output current and the desired output current. Official Gazette of the U.S. Patent Office

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N71-19405 Stanford Univ., Calif.

PHOTOVOLTAIC PROPERTIES OF Cu2S-CdS HETEROJUNCTIONS

William Delahaye Gill (Ph.D. Thesis) 1969 200 p Avail: Univ. Microfilms: HC $9.00/Microfilm $3.00 Order No. 70-1534

A model is proposed in which hole-trapping at levels introduced in the CdS by heat treatment varies the transparency of a conduction band spike to photoexcited electrons tunnelling from the Cu2S which are responsible for the long wavelength response. Enhancement and quenching effects are related to changes in hole occupancy of these levels. The reverse breakdown observed under short wavelength illumination is explained by light-induced Zener breakdown at high field points on the junctions. Dissert. Abstr.

N71-19417* Grumman Aircraft Engineering Corp., Bethpage, N.Y.

OUT OF TOLERANCE WARNING ALARM SYSTEM FOR PLURALITY OF MONITORED CIRCUITS Patent

Urbano Bandini, inventor (to NASA) Issued 6 Oct. 1970 (Filed 27 Dec. 1966) 5 p Cl. 340-213.1; Int. Cl. G08b25/00 Sponsored by NASA (NASA-Case-XMS-10984-1; US-Patent-3,533,093; US-Patent-Appl-SN-605095) Avail: US Patent Office CSCL 09C

An alarm circuit is described monitoring one or more relay circuits in order to signal the closed condition of a monitored relay, the automatic initial energization of the alarm signal by one circuit and the continued energization and manual de-energization of the alarm signal by another circuit is outlined. So long as the monitored relay remains closed after the alarm signal is manually de-energized, the initial energization circuit does not re-energize the alarm signal and does not do so for a predetermined period of time after the opening of the monitored relay. In the case of a plurality of relay circuits being monitored by a single alarm signal, the alarm may be energized by the closing of a second monitored relay even though the alarm was previously de-energized by the manual control circuit and the first monitored relay is still closed.

Official Gazette of the U.S. Patent Office

N71-19418* Honeywell, Inc., Hopkins, Minn. Ordnance Div.

FREQUENCY CONTROL NETWORK FOR A CURRENT FEEDBACK OSCILLATOR Patent

John T. Lingle, inventor (to NASA) Issued 29 Jul. 1969 (Filed 20 Nov. 1967) 4 p Cl. 331-113; Int. Cl. H03k3/28; Int. Cl. H02m3/22 Sponsored by NASA (NASA-Case-GSC-10041-1; US-Patent-3,458,833; US-Patent-Appl-SN-684209) Avail: US Patent Office CSCL 09C

A transistor multivibrator used in converting dc voltages to ac voltages or higher dc voltages, with a negative feedback path is described. A switching network which fires or switches at a predetermined potential applies negative and positive feedback to the multivibrator to change its state.

Official Gazette of the U.S. Patent Office

N71-19419 Minnesota Univ., Minneapolis.

HOT ELECTRON TRANSPORT IN VACUUM DEPOSITED THIN FILM EMISSION DIODES

Rodney Joseph Soukup (Ph.D. Thesis) 1969 208 p Avail: Univ. Microfilms: HC $9.45/Microfilm $3.00 Order No. 70-1819

Several series of experiments were performed to establish the mechanism of current flow in vacuum deposited Au-MgO-Au thin film sandwich devices in which each layer was deposited from a high purity source of electron beam evaporation. The emission of electrons into vacuum from these devices was also measured. Current-voltage characteristics were analyzed to determine the current flow mechanism. The current was linearly dependent upon voltage for low fields and eventually reached a dependence such that Inl was proportional to V(1/2). The results indicate that a Schottky type emission process or a Poole-Frenkel conduction process would explain the results in a qualitative manner.

Dissert. Abstr.

N71-19421* Consolidated Electrodynamics Corp., Monrovia, Calif.

INSTRUMENT FOR MEASURING POTENTIALS ON TWO DIMENSIONAL ELECTRIC FIELD PLOTS Patent

George M. Woods, Jr., Charlie E. Dameron, and Robert D. Boles, inventors (to NASA) Issued 6 Oct. 1970 (Filed 31 Jul. 1968) 5 p Cl. 324-72; Int. Cl. G01r17/02 Sponsored by NASA (NASA-Case-XLA-08493; US-Patent-3,532,975; US-Patent-Appl-SN-749148) Avail: US Patent Office CSCL 09C

An instrument is described for determining equipotential lines on a two dimensional electric field plot and for measuring the potential at any selected point on the plot. The essential elements

of the instrument are a dual triode for comparing the potentials applied to its two grids with a probe connected to one of its grids and with means for applying measured potentials to its other grid.
Official Gazette of the U.S. Patent Office

N71-19422*# GTE Labs., Inc., Waltham, Mass. Research Center.
BEAM LEAD TECHNOLOGY
T. W. Fitzgerald, K. Anderson, V. J. Barry, N. Cerniglia, J. Coulthard et al 15 Mar. 1971 92 p refs
(Contract NAS1-10226)
(NASA-CR-111838) Avail: NTIS CSCL 09C

A literature survey was conducted on the current technical state-of-the-art in the beam lead technique of microcircuit interconnection. The material presented covers the areas of metallization, passivation, bonding, and reliability. Recommendations are made concerning these areas and include mechanical standards and bond testing. Author

N71-19427# Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.
A DISCUSSION ON THE APPLICATION OF MODERN OPTIMAL CONTROL THEORY TO A POWER SYSTEM
Thomas W. Reddoch and Paul M. Julich Sep. 1970 18 p refs
(Contract F44620-68-C-0021; Proj. Themis)
(AD-716552; THEMIS-LSU-T-TR-39; AFOSR-70-2813TR) Avail: NTIS CSCL 12/1

A computer program has been written to obtain the optimal control for a two-area linear power system for the megawatt-frequency control problem. This program has been used to analyze the results of two papers written by O. I. Elgerd and C. E. /Fosha, Jr. appearing in the April 1970 issue of Transactions on Power Apparatus and Systems. Author (GRA)

N71-19428# Hawaii Univ., Honolulu
A NOTE ON THE MULTIDIMENSIONAL SAMPLING THEOREM
N. Thomas Gaarder Nov. 1970 11 p refs
(Contract AF-AFOSR-1251-67)
(AD-716557; AFOSR-70-2746TR) Avail: NTIS CSCL 9/4

The multidimensional sampling theorem is extended to allow non-uniform, but periodic, sampling with explicit and simple reconstruction formulas. The extension is applicable to hexagonal, and other non-rectangular, lattices; such sampling schemes can be as efficient as rectangular sampling. Author (GRA)

N71-19467* Motorola, Inc., Phoenix, Ariz.
AUTOMATIC FREQUENCY DISCRIMINATORS AND CONTROL FOR A PHASE-LOCK LOOP PROVIDING FREQUENCY PRESET CAPABILITIES Patent
William D. Peterson and Arthur J. Kline, Jr., inventors (to NASA) Issued 30 Sep. 1969 (Filed 28 Sep. 1966) 10 p Cl. 325-63; Int. Cl. H04b1/06, 1/38 Sponsored by NASA
(NASA-Case-XMF-08665; US-Patent-3,470,475; US-Patent-Appl-SN-582609) Avail: US Patent Office CSCL 09C

An automatic frequency control system providing automatic pre-setting of a phase-lock loop to a desired center frequency by using a closed-loop electronic frequency discriminator, and holding the phase-lock loop to such center frequency until phase-lock is achieved is described. The frequency pre-setting system utilizes a digital frequency discriminator plus a reference signal in a digital type nonlinear frequency lock loop. The digital frequency discriminator control signal alters the phase-lock loop so that the loop is preset to a given or selected center frequency and oscillated above the center frequency in looking for or attempting to find the received signal. The phase-lock loop transfer characteristics are modified only slightly by the additional presetting circuitry enabling the phase-lock loop to operate normally after phase lock to the signal, thereby overriding the frequency preset. The reference signal may be provided by another communication channel.
Official Gazette of the U.S. Patent Office

N71-19468* Lockheed Electronics Co., Houston, Tex.
BURST SYNCHRONIZATION DETECTION SYSTEM Patent
Phillip C. Lipoma and Bryant P. Seay, Jr., inventors (to NASA) Issued 6 Oct. 1970 (Filed 3 Oct. 1968) 9 p Cl. 178-69.5; Int. Cl. H04n5/04 Sponsored by NASA
(NASA-Case-XMS-05605-1; US-Patent-3,532,819; US-Patent-Appl-SN-764812) Avail: US Patent Office CSCL 09C

A burst synchronization detection system for a television system which employs repetitive bursts of a sine wave signal for synchronization purposes is described. The system operates to separate the synchronizing bursts from the remainder of the incoming signal and to supply such bursts to a phase locked loop which operates to lock a voltage controlled oscillator in the loop in synchronism with the sine wave component of the synchronizing bursts. Pulse type signals from the oscillator are supplied to a first pulse counter for producing horizontal sync pulses having the same repetition rate as the sync bursts. The horizontal sync pulses are supplied to a second pulse counter for producing vertical sync pulses having the same repetition rate as the vertical sync intervals in the incoming signal. Official Gazette of the U.S. Patent Office

N71-19469* Hughes Aircraft Co., Los Angeles, Calif.
PHASE DEMODULATION SYSTEM WITH TWO PHASE LOCKED LOOPS Patent
Thomas Hudspeth, inventor (to NASA) Issued 23 Jun. 1970 (Filed 10 Sep. 1965) 9 p Cl. 329-122; Int. Cl. H03d3/24; Int. Cl. H03f3/06
(NASA-Case-XNP-00777; US-Patent-3,517,268; US-Patent-Appl-SN-486573) Avail: US Patent Office CSCL 09C

A phase demodulation system is disclosed in which a phase modulated carrier frequency is operated upon to provide an output which represents the frequency modulation of the carrier signal. The system includes a first stage, which includes a phase locked loop to which the frequency modulated carrier frequency is supplied, designed to provide a first output which represents a frequency modulated intermediate frequency and a second output which consists of an unmodulated intermediate frequency, the intermediate frequencies of the two outputs having a constant phase relationship. The two outputs are supplied to a second stage, forming a phase locked loop to produce the desired system output.
Official Gazette of U.S. Patent Office

N71-19471* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PULSED DIFFERENTIAL COMPARATOR CIRCUIT Patent
John C. Sturman, inventor (to NASA) Issued 26 Aug. 1969 (Filed 10 Feb. 1966) 6 p Cl. 307-235; Int. Cl. H03k5/20
(NASA-Case-XLE-03804; US-Patent-3,463,939; US-Patent-Appl-SN-526631) Avail: US Patent Office CSCL 09E

A comparator circuit is provided in which two nonvarying voltages to be compared are fed through a differential amplifier to respective ones of a pair of input transistors connected in a differential amplifier configuration. The emitter-collector circuits of the input transistors are connected through the emitter-collector circuits of respective ones of a pair of amplifying transistors and through a gate circuit to a D-C potential, the amplifying transistors serving as loads for the input transistors. A first output is derived at a point between one of the input transistors and the amplifying transistor. This output is applied across a dummy load and is also directed through feedback networks to the other input transistor and the other amplifying transistor. A second output is derived between the other input transistor and the other amplifying transistor. This second output is fed to a NAND circuit and is also directed through feedback networks to the one input transistor and the amplifying transistor. Official Gazette of the U.S. Patent Office

N71-19472* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DEMODULATION SYSTEM Patent
William J. Kerwin, Michael G. Dix, and Robert M. Munoz, inventors (to NASA) Issued 26 Aug. 1969 (Filed 13 Jan. 1966) 9 p Cl. 328-1; Int. Cl. G01n27/00
(NASA-Case-XAC-04030; US-Patent-3,464,016; US-Patent-Appl-SN-520839) Avail: US Patent Office CSCL 09C

A demodulation system for removing unwanted amplitude modulation from two quadrature-displaced data-bearing signals is described. Quadrature related reference signals locked in frequency and phase to the amplitude modulation function are generated. The reference signals and data-bearing signals are processed in multipliers, an inverter, and adders to provide data-bearing signals that have been stripped of the amplitude modulation.
Official Gazette of the U.S. Patent Office

N71-19547* Sperry Rand Corp., Blue Bell, Pa. UNIVAC Div.
FLIPFLOP INTERROGATOR AND BI-POLAR CURRENT DRIVER Patent
Carlos F. Chong and Charles A. Nelson, inventors (to NASA) Issued 23 Jun. 1970 (Filed 29 Jul. 1966) 5 p Cl. 307-289; Int. Cl. H03k3/12 Sponsored by NASA
(NASA-Case-XGS-03058; US-Patent-3,517,221; US-Patent-Appl-SN-568987) Avail: US Patent Office CSCL 09C

An interrogator and current driver circuit is described for combination with a transistor flipflop circuit. The flipflop operates nominally in a saturated state at very low levels of collector current. During interrogation, the load resistance of the conducting transistor is reduced and the conducting transistor is provided with additional base drive to sustain higher saturation currents so that the conducting transistor of the flip-flop operates as the current driver amplifier. Official Gazette of the U.S. Patent Office

N71-19716# California Univ., Berkeley. Operations Research Center.
A NOTE ON DUALITY IN NETWORK FLOWS
Michel F. Sakarovitch Nov. 1970 16 p refs
(Contract DA-31-124-ARO(D)-331)
(AD-716582; ORC-70-36; AROD-5307-53-M) Avail: NTIS CSCL 12/2

Two concepts of duality are introduced in the network flow theory: The topological notion of dual graph which is associated to planar networks, the analytical notion of duality between flows and potentials associated to the same network. By combining these two notions, it is known that a max-flow problem in a planar network is equivalent to a shortest route problem in the topological dual graph. This correspondence is described with precision here.
Author (GRA)

N71-19722*# Mississippi State Univ., State College. Dept. of Electrical Engineering.
COMPENSATOR GROWING AND IMPROVING PROGRAM Interim Report, 1 Sep. 1970 – 31 Jan. 1971
Jerrel R. Mitchell 4 Mar. 1971 51 p refs
(Contract NAS8-21377)
(NASA-CR-103066) Avail: NTIS CSCL 09C

A computer-aided compensator design program is presented for increasing the relative stability of a control system. The various routines for performing compensator growing are given, along with explanatory notes for specialized functions not commonly available in computing facility libraries. All the programs are written in FORTRAN 5, and the whole program is self-dependent (does not depend upon the system library). Author

N71-20178# Aktiebolaget Atomenergi, Studsvik (Sweden).
REDUCTION OF NOISE IN CLOSED LOOP SERVO SYSTEMS
K. Nygaard 1970 24 p refs
(AE-404) Avail: AEC Depository Libraries

A noise power reduction of more than three powers of ten was obtained in a loop simulated on an analog computer. The noise reduction was achieved under the condition that the dynamic behavior of the loop should remain unchanged. It is characteristic of the method shown that it can be used without particular knowledge of the noise power frequency spectrum and that noise power measurements are not demanded. Author (NSA)

N71-20328# Stanford Univ., Calif. Dept. of Electrical Engineering.
AN INNOVATIONS APPROACH TO LEAST SQUARES ESTIMATION. PART 4: RECURSIVE ESTIMATION GIVEN THE COVARIANCE FUNCTIONS
T. Kailath and R. Geesey 1970 24 p refs
(Contract F44620-69-C-0101)
(AD-716477) Avail: NTIS CSCL 9/4

One shows how to recursively compute linear least-squares filtered and smoothed estimates for a lumped signal process in additive white noise. However, unlike the Kalman-Bucy problem, here only the covariance function of the signal process is known and not a specific state-variable model. The solutions are based on the innovations representation for the observation process.
Author (GRA)

N71-20448* Raymond Engineering Lab., Inc., Middletown, Conn.
SYNCHRONOUS SERVO LOOP CONTROL SYSTEM Patent
Frederick A. Stone, inventor (to NASA) Issued 28 Jan. 1969 (Filed 4 May 1966) 7 p Cl. 318-314; Int. Cl. H02p5/00 Sponsored by NASA Prepared for JPL
(NASA-Case-XNP-03744; US-Patent-3,424,966; US-Patent-Appl-SN-547677) Avail: US Patent Office CSCL 09C

A control system for a tape recorder playback motor in which the derived signals from the tape are synchronized with signals from a clock signal source is described. An integrator circuit is provided which is charged to a fixed initial reference voltage lead when the clock signal occurs. As long as both signals are present, the integrator output falls at a fixed rate. In the absence of one of the signals, the integrator holds its output value. The output of the integrator is used to control an oscillator whose output drives the tape recorder playback motor.
Official Gazette of the U.S. Patent Office

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N71-19401# National Research Council of Canada, Ottawa (Ontario).
DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT Quarterly Bulletin, 1 Jul. – 30 Sep. 1970
30 Sep. 1970 75 p refs
(DME/NAE-1970(3)) Avail: NTIS

CONTENTS:
1. DEVELOPMENT OF AN EXPERIMENTAL METHODOLOGY FOR STUDYING MOTOR VEHICLE IMPACTS WITH FLEXIBLE SAFETY BARRIERS G. L. Basso, H. F. L. Pinkney and G. F. W.

McCaffrey p 1–26 refs (See N71-19402 09-32)

2. NAE MULTI-SOURCE SCHLIEREN APPARATUS FOR 5-FOOT × 5-FOOT TRISONIC WIND TUNNEL A. Bowker p 27–49 refs (See N71-19403 09-11)

N71-19403# National Aeronautical Establishment, Ottawa (Ontario). High Speed Aerodynamics Lab.

NAE MULTI-SOURCE SCHLIEREN APPARATUS FOR 5-FOOT × 5-FOOT TRISONIC WIND TUNNEL

A. Bowker *In* Natl. Res. Council of Canada Div. of Mech. Eng. and The Natl. Aeron. Estab. 30 Sep. 1970 p 27–49 refs (See N71-19401 09-11)

Avail: NTIS

The in-house development of a multiple-source schlieren system for the National Aeronautical Establishment Trisonic wind tunnel is described. The basic optical elements and their mechanical arrangements are shown in schematics. The control panels, and operational procedures are also described. F.O.S.

N71-19426# Gage-Babcock and Associates, Inc., Westchester, Ill.

MINIMUM NEEDS FOR AIRPORT FIRE FIGHTING AND RESCUE SERVICES Final Report

Bert M. Cohn and John A. Campbell Jan. 1971 95 p refs

(Contract DOT-FA71WA-2487)

(FAA-AS-71-1; Rept-7113) Avail: NTIS

In order to develop minimum standards for airport fire fighting and rescue services complying with the intent of the Airport and Airway Development Act of 1970, a study was made of the needs for different categories of airports serving air carriers certificated by the Civil Aeronautics Board. The study consisted of a review of the state-of-the-art, analysis of accident reports, extrapolation of data from various sources, and discussions concerning these services with various owner and user oriented organizations. Recommendations are presented for adoption as the minimum requirements covering quantities and application rates for fire extinguishing agents, the number of vehicles to transport the agents, vehicle response times, manning, and other related elements which comprise these services. Author

N71-19434# Gibbs and Hill, Inc., New York.

AIRPORT ACCESS STUDY: FRIENDSHIP INTERNATIONAL AIRPORT

Sep. 1970 210 p Sponsored in part by Federal Railroad Admin.

(PB-196023) Avail: NTIS CSCL 13F

The study indicates that the most attractive method of providing rail access to Friendship International Airport from the metropolitan centers of Washington, D.C. and Baltimore, Md. would be through the implementation of a high-speed electric service running directly to a new railroad terminal at the Airport from Union Station in Washington and Camden Station in Baltimore. Use would be made of existing Penn Central and Baltimore and Ohio Railroad routes and facilities, with a connection between the two at Winans and an additional track on the Penn Central. Author (GRA)

N71-19494* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

MECHANICAL SIMULATOR OF LOW GRAVITY CONDITIONS Patent

Dan H. Dane, inventor (to NASA) Issued 23 Jun. 1970 (Filed 26 Jan. 1968) 8 p Cl. 35-12; Int. Cl. B64g7/00; Int. Cl. G09b9/00; Int. Cl. E04h12/34

(NASA-Case-MFS-10555; US-Patent-3,516,179; US-Patent-Appl-SN-700984) Avail: US Patent Office CSCL 14B

A mechanical simulator for giving a test subject such as an astronaut six-degree freedom of movement on the earth is described. A truss supported on air bearing pads is utilized to support an elongated column having at its lower end a yoke and beam arrangement which supports the test subject for pitch, yaw, and roll movements. The vertical movement of the elongated column is controlled by constant force springs attached to the truss. Official Gazette of the U.S. Patent Office

N71-19495# McMaster Univ., Hamilton (Ontario).

NUCLEAR SCIENCE RESEARCH REPORT

Jan. 1971 190 p refs

Avail: NTIS

Progress reports are presented on nuclear structure research and applications of nuclear techniques to research in other fields. The reactors, accelerators, and the operations of the facilities are described. Nuclear structure is studied by use of nuclear reactions, fission, magnetic resonance, nuclear chemistry, chronometry, and beta, gamma ray, nuclear pulse, and mass spectrometry. Results are presented of research applying nuclear techniques to solve problems dealing with solid state physics materials, chemistry, geology, engineering, biochemistry, biology, and medicine. N.E.N.

N71-19556# California Univ., Berkeley. Lawrence Radiation Lab.

ELECTRON RING ACCELERATOR PROGRAM AT THE LAWRENCE RADIATION LABORATORY

Edwin M. McMillan 18 Aug. 1970 20 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev, 1970

(Contract W-7405-eng-48)

(UCRL-20084; CONF-700806-52) Avail: NTIS

Work at LRL on the electron-ring accelerator is outlined. The experimental program including the new injector facility is briefly discussed and future possibilities of the electron-ring accelerator are considered. NSA

N71-19611# Rhode Island Statewide Comprehensive Transportation and Land Use Planning Program, Providence.

STATE AIRPORT SYSTEM AIRLINE PASSENGER TICKET SURVEY

Sep. 1970 41 p Sponsored in part by HEW and DOT *Its* Tech. Paper No. 17

(PB-195939) Avail: NTIS CSCL 01E

In the course of collecting data for a report on state airport system plan criteria and forecasts, 1970–1990, a survey was conducted involving all the airlines at Theodore F. Green State Airport to determine the number of passengers carried and their destinations. It was decided to compile the data received into a separate technical paper for use in preparing projections of future air transportation demands and in determining the requirements for the state airport system for the next 20 years. Author (GRA)

N71-19630*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

ACOUSTICAL EVALUATION OF THE NASA LANGLEY FULL-SCALE WIND TUNNEL

Istvan L. Ver, Charles I. Malme, and Eugene B. Meyer 15 Jan. 1971 35 p refs

(Contract NAS1-9559)

(NASA-CR-111868; Rept-2100) Avail: NTIS CSCL 14B

The acoustical measurements done at the NASA Langley Research Center's Full Scale Wind Tunnel are summarized. The purpose of these measurements was to supply NASA Langley operating personnel with data indicating the types of acoustical measurements which can be undertaken in the tunnel test section. The series of measurements included: (1) evaluation of the octave band ambient noise level in the test section with the tunnel fans stationary; (2) evaluation of the octave band noise levels in the test section as a function of the air speed in three different locations in the tunnel test section; (3) mapping of the sound field of an omnidirectional continuous broadband sound source of known

power output; and (4) measurement of decay rate in the test section and in certain other locations in the tunnel. An analysis of the measured data indicates that the test section of the full scale wind tunnel has potential as an environment for performing some types of acoustical measurements. The validity of the test results is dependent upon the type of noise source to be investigated (on the acoustical power output, radiation pattern frequency spectrum and dimensions of the source), the distance from the source where measurements are to be taken, and upon the air flow conditions. Author

N71-19868# Naval Ordnance Lab., White Oak, Md. Chemical Engineering Div.

FACILITIES FOR PREPARATION OF HIGH EXPLOSIVE AND BOOSTER EXPLOSIVE CHARGES AT NOL

Carroll C. Misener 2 Sep. 1970 44 p

(AD-716036; NOLTR-70-152) Avail: NTIS CSCL 13/8

The studies of the properties of explosives including the effects of explosions require the preparation of high quality explosive charges. Such programs may demand unusual combinations, shapes, and densities of energetic materials. These requirements necessitate specialized facilities and skills where safety as well as control of process are exceedingly important. The report describes the facilities in the Chemical Engineering Division of the Chemical Research Department for the accomplishment of this work. Author (GRA)

N71-19702# Army Foreign Science and Technology Center, Washington, D.C.

AIRPORTS: THE MILITARY POSITION OF AVIATION

V. K. Buzunov 16 Oct. 1970 110 p refs Transl. into ENGLISH of the book 'Aerodromy: Boevaya Pozitsiya Avaitsii' Moscow, 1969 p 3–124

(AD-716603; FSTC-HT-23-036-71) Avail: NTIS CSCL 1/5

The book deals primarily with military airfields, describing types, design and construction, operation and management. It discusses the functions an airfield must perform to support aviation and how an airfield is organized to carry out these functions, e.g., flight service, maintenance, armament, refueling, traffic control, etc. Author (GRA)

N71-19715# Naval Ordnance Lab., White Oak, Md. Nonmetallic Materials Div.

A DIELECTRIC TEST CELL FOR POLYMER FILMS

Joseph M. Augl 30 Sep. 1970 10 p refs

(AD-716041; NOLTR-70-183) Avail: NTIS CSCL 14/2

A simple laboratory apparatus is described for the determination of dielectric constants on polymer films. Author (GRA)

N71-19855*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SERT 2 CONTROL CENTER

John G. Wozencraft Washington Mar. 1971 21 p

(NASA-TM-X-2217; E-5966) Avail: NTIS CSCL 14B

A control center with an integrated computer for real-time processing and display of information from the SERT 2 spacecraft is described. Data received from the spacecraft through the NASA Goddard Space Flight Center world-wide Space Tracking and Data Acquisition Network are converted to engineering units, limit-checked, and displayed for evaluation by SERT 2 engineers to determine spacecraft status and command requirements. Commands sent to the spacecraft are returned by telemetry to the control center for verification before execution. Author

N71-19865# Rhode Island State Planning Program, Providence.

STATE AIRPORT SYSTEM AIRLINE PASSENGER TICKET SURVEY

Oct. 1970 19 p refs Supplement to PB-195939 *Its* Tech. Paper No. 17, Suppl. 1

(PB-195940) Avail: NTIS CSCL 01E

The document is a supplement which summarizes the second phase of an airline passenger ticket survey. The format of the survey and a summary of the first phase was reported in N71-19611. The present survey was carried out in an identical manner. Author (GRA)

N71-19916# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

INVESTIGATION OF THE HYDRODYNAMICAL PROCESSES AND THE PARAMETERS OF THE GLASS MOTION IN A LARGE BUBBLE CHAMBER

Yu. F. Lomakin and R. V. Chvantatsky 1970 22 p refs In RUSSIAN

(JINR-P13-5291) Avail: AEC Depository Libraries

A general investigation is performed of the homogeneity of the pressure field in the working liquid of a large bubble chamber with a floating glass partition that separates two different liquids in the chamber. The parameters of the glass motion necessary for calculation of the glass strength and for estimation of the optical distortions are determined. Author (NSA)

N71-19967*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

MSC APOLLO 13 INVESTIGATION TEAM. PANEL 6: RELATED SYSTEMS EVALUATION. VOLUME 4: GOVERNMENT FURNISHED EQUIPMENT AND GROUND SUPPORT EQUIPMENT Final Report

May 1970 95 p

(NASA-TM-X-66920) Avail: NTIS CSCL 13F

Apollo flight government furnished equipment (GFE) was reviewed to identify all high pressure vessels and oxygen systems included in the various GFE end items. The data which were used to assess the adequacy of the design and testing programs are summarized. The results of this assessment for the pressure vessel and related O2 systems are presented. Systems investigated are: (1) PLSS (Portable Life Support System O2 Bottle), (2) OPS (Oxygen Purge System) O2 Bottles, (3) Life Raft CO2 Cylinders, (4) Life Vest CO2 Cartridges, (5) RTG (Radioisotope Thermal Generator) Capsule, (6) LGEC (Lunar Geological Exploration Camera) Gas Bottles, and (7) PSE (Passive Seismic Experiment) Caging System. Author

N71-19969# Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule.

REVIEW OF THE INCINERATION OF 500 TONS OF RADIO-ACTIVE RESIDUES [BILAN DE L'INCINERATION DE 500 TONNES DE RESIDUS RADIOACTIFS]

Jean Rodier, Philippe Seyfried, and Michel Charbonnesux Apr. 1969 14 p refs In FRENCH

(CEA-R-3721) Avail: AEC Depository Libraries

The incinerator at the Marcoule Center has burned almost 500 tons of radioactive residues. Improvements in some of the details of the process have been made; they concern the nature of the materials involved. The technical and radiological results for the installation are very favorable, and have made it possible to maintain a high charge factor. Although the overall economic results are not advantageous in the case of ungraded solid residues, this method is the best available for eliminating oils, solvents, wood, and dead animals. It can also be of use each time that a dilution in the atmosphere can advantageously be used as a method of disposing of certain radioelements such as tritium or carbon-14 in the form of gases or vapors. Author (NSA)

N71-20095# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

TORSATRON WITHOUT TOROIDAL FIELD COILS AS A

POSSIBLE SOLUTION TO THE DIVERTOR PROBLEM IN A FUSION REACTOR

C. Gourdon, D. Marty, and J. Touche 1970 6 p refs Presented at the 6th Symp. on Fusion Technol., Aachen, 22–26 Sep. 1970 Sponsored by Euratom

(CEA-CONF-1664; CONF-700928-4) Avail: AEC Depository Libraries

A new type of stellarator configuration, Torsatron, is described with only one set of helical conductors passing currents in the same direction instead of opposite directions such as in the classical type of stellarator. A peculiar regime in which the whole toroidal field is created only by the helical current was found to have very interesting properties. With large aspect ratio in the l = 3 case, high values for the rotational transform and high shear can be reached. The simplicity of the windings and the particular shape of 1the separatrix can be used in the design of an efficient diverter. The absence of toroidal field coils permits the extremely large pumping apertures required to maintain a low equilibrium pressure in the diverter chamber under reactor conditions, the neutral gas density around the plasma is about 2 × 10 to the 11th power/cu cm. Author (NSA)

N71-20151# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Kernphysik.

RECENT DEVELOPMENT AT THE JUELICH ISOCHRONOUS CYCLOTRON

C. Mayer-Boericke May 1970 37 p Presented at the 7th European Cyclotron Progr. Meeting, Eindhoven, Neth., 14 Apr. 1970

(JUL-665-KP; CONF-700428-1) Avail: AEC Depository Libraries

The beams of the Juelich Isochronous Cyclotron are described. The external and internal beams, extraction and matching condition, the emittance measuring device, test measurements with the external beams, and the beam-handling and monochromator system are discussed. NSA

N71-20191*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A WIND TUNNEL INVESTIGATION OF HELICOPTER DIRECTIONAL CONTROL IN REARWARD FLIGHT IN GROUND EFFECT

Robert J. Huston and Charles E. K. Morris, Jr. Washington Mar. 1971 40 p refs

(NASA-TN-D-6118; L-7432) Avail: NTIS CSCL 14B

An investigation was conducted in the Langley full-scale tunnel to study the aerodynamics that produce directional-control problems for a helicopter with a tail rotor in low-speed rearward flight in ground effect. A helicopter model mounted close to the tunnel floor was tested in tail winds from 0 to 25 knots. Author

N71-20192# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

FAST NEUTRAL HYDROGEN ATOM INJECTOR

A. Bariaud, R. Becherer, R. Dei-Cas, J. Druaux, and F. P. G. Valckx 1970 7 p refs Presented at the 6th Symp. on Fusion Technol., Aachen, 22–26 Sep. 1970 Sponsored in part by Euratom

(CEA-CONF-1662; CONF-700928-2) Avail: NTIS

This fast-neutral injector facility which was built to test the feasibility of obtaining an intense neutral excited hydrogen atom beam in a good vacuum for a multi-injection project is described. Hydrogen ions were chosen for the following reasons: the extraction is easier; the production efficiency of excited atoms is higher with a thick vapor target; the energy can be varied without significantly affecting this efficiency. The experimental device consists of an ion source of the type developed at Sukhumi and Oak Ridge, a neutralizer that uses a supersonic Mg vapor jet for the neutralization of the ion beam and partial breakup of the neutral gas jet coming from the source, deflection magnet to eliminate the charged beam fraction, a differential pumping column using titanium getter pumps, and an analyzing device to measure the state of excitation of the atoms. Author (NSA)

N71-20193# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

TOKAMAK FACILITY OF FONTENAY-AUX-ROSES: TFR

J. L. Beraud, P. H. Rebut, M. Huguet, Z. Sledziewski, and A. Torossian 1970 6 p refs Presented at the 6th Symp. on Fusion Technol., Aachen, 22–26 Sep. 1970 Sponsored in part by Euratom

(CEA-CONF-1661; CONF-700928-3) Avail: AEC Depository Libraries

A T3-sized Tokamak device energized by a recently developed 100 MW alternator supplying 150 MJ at a repetition rate of one pulse every four minutes is described. The maximum diameter of the torus is 2 meters, the internal diameter of the coil 0.6 meters and the on-axis magnetic field is 60 kG. NSA

N71-20201# National Bureau of Standards, Washington, D.C. Inst. for Basic Standards.

SPACE SIMULATION

Joseph C. Richmond, ed. Oct. 1970 968 p refs Conf. held at Gaithersburg, Md., 14–16 Sep. 1970; sponsored in part by the Am. Soc. for Testing and Mater., Inst. of Environ. Sci., and AIAA

(NBS-SP-336) Avail: SOD $5.25

Space simulation technology aspects are discussed that encompass all phases of simulating the space environment and determining its effects on materials, components, spacecraft, and man. Predictive testing procedures and spacecraft decontamination methods are included. For individual titles, see N71-20202 through N71-20255.

N71-20203# Brown and Root, Inc., Houston, Tex.

CONTAMINATION MEASUREMENT IN SPACE ENVIRONMENT SIMULATION CHAMBERS

Calvin M. Wolff and Melvin L. Ritter *In* NBS Space Simulation Oct. 1970 p 25–49 refs (See N71-20201 09-11)

Avail: SOD $5.25

Contamination measurement is classified according to the requirements; i.e., the identity, sources, and effects of contamination by active and passive sampling. The chemical nature of the most common contaminants found in space environment simulation is discussed. Qualitative and quantitative techniques for contaminants analyses are described and evaluated. These techniques include mass spectrometry, quartz crystal oscillator mass monitors, infrared spectrometry, and gas-liquid chromatography. Also, the uses of optical surfaces and thermal control coatings as contaminants effects monitors are described. Author

N71-20215*# Bureau of Mines, Minneapolis, Minn. Twin Cities Mining Research Center.

METHOD FOR ROCK PROPERTY DETERMINATION IN ULTRAHIGH VACUUM

Egons R. Podnieks and Peter G. Chamberlain *In* NBS Space Simulation Oct. 1970 p 209–223 refs Sponsored by NASA (See N71-20201 09-11)

(NASA-CR-117139) Avail: NTIS; SOD $5.25 CSCL 14B

A special ultrahigh vacuum system was designed for determining deformational and strength properties of simulated lunar rocks. The system provides a vacuum of 10 to the minus 9th power to 10 to the minus 10th power torr depending on the specimen size and rock type. Specimens of tholeiitic basalt, dacite, and semiwelded tuff were used. Special procedures in specimen preparation and preconditioning were developed. During the pumpdown period, prolonged roughing and an initial bakeout produced significantly low final pressures in the chamber. Test data presented include a typical load-deformation curve from rock specimen in ultrahigh vacuum, outgassing characteristics during loading in terms of pressure variation, and changes in the composition of gases being released by the specimen. Author

N71-20234# Raytheon Co., Sudbury, Mass. Equipment Div.
A SIMULATION TO VALIDATE FUTURE SPACE MISSIONS
T. P. Foley, A. W. Metz, and A. W. Yonda *In* NBS Space Simulation Oct. 1970 p 535–547 (See N71-20201 09-11)
Avail: SOD $5.25

A simulation for aerospace systems analysts has been developed so that design engineers can study the performance of their design in a total system environment before hardware is fabricated. The parameters of the simulation permit the configuration of models against input parameters which when varied provide information on system performance. Thus, many different projected system configurations can be quickly exercised and discarded until only a few feasible system configurations remain. Provision is made for entry of errors into the system so that performance characteristics of the system in a degraded state can be studied. Author

N71-20235# Naval Electronics Lab. Center for Command Control and Communications, San Diego, Calif. Performance Monitoring Systems Div.
GENERAL PURPOSE CENTRALIZED AUTOMATIC TESTING FOR IMPROVEMENT OF SHIPBOARD SYSTEM PERFORMANCE
F. J. Zupan *In* NBS Space Simulation Oct. 1970 p 549–568 refs (See N71-20201 09-11)
Avail: SOD $5.25

Increased operational effectiveness of shipboard systems is the primary goal of the automatic testing program. The rationale and techniques utilized in developing an experimental model which will help update and modernize traditional methods and approaches to systems monitoring and maintenance are reported. Developments in acquisition, processing and dissemination of information as related to a centralized on-line performance monitoring system are covered. Both laboratory and shipboard functional tests were performed, with a laboratory model system monitoring typical Navy electronic and non-electronic systems. Test results, a discussion of problem areas, and a prediction of the impact of centralized testing on shipboard maintenance and operating organization are included. Author

N71-20237# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
THE DYNAMIC ENVIRONMENT SIMULATOR: A MULTIENVIRONMENTAL MAN RATED CENTRIFUGE
Dana B. Rogers, Michael McCally, and Klaus L. Cappel (Franklin Inst., Philadelphia, Pa.) *In* NBS Space Simulation Oct. 1970 p 587–598 (See N71-20201 09-11)
Avail: SOD $5.25

The dynamic environment simulator generates combinations, either simultaneous or sequential, of acceleration, vibration, temperature, barometric pressure, gas composition, noise and related environmental stresses. Simulation of a broad variety of aerospace flight mission environments is also possible. The dynamic environment simulator represents a capability of supporting the requirements of many programs where man is exposed to physical environmental stresses in combination. Author

N71-20238*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
USE OF THE BEN FRANKLIN SUBMERSIBLE AS A SPACE STATION SIMULATOR
Mattew J. Ferguson (Grumman Aerospace Corp.) and Chester B. May *In* NBS Space Simulation Oct. 1970 p 599–621 (See N71-20201 09-11)
(NASA-TM-X-66943) Avail: NTIS; SOD $5.25 CSCL 14B

A submersible was used as a space station analog during a 30 day drift mission. Areas of investigation include: (1) psychological and physiological measurements related to observed crew behavior. Results show that selection of crew pairs for compatibility of personality will reduce stress in small closed systems; (2) habitability in closed ecosystem in order to determine the suitability of submersible habitability data for providing guidelines for future spacecraft design; (3) the effect of total biological isolation upon the flora of the crew, and environmental and life support subsystems; and (4) information on the frequency, duration, type, and complications of onboard maintenance during the mission. Author

N71-20240# Ocean Systems, Inc., Washington, D.C.
ADVANCED DIVING TECHNIQUES APPLICABLE TO EXTENDED MISSION NEUTRAL BUOYANCY SPACE SIMULATION
Joseph B. Mac Innis and C. M. McClure (Aquaspace) *In* NBS Space Simulation Oct. 1970 651–659 refs (See N71-20201 09-11)
Avail: SOD $5.25

Diving methodology is reviewed. Nonsaturated diving is recognized as the basis for almost all neutral buoyancy testing to date. Saturated diving methodology is reviewed and its possible special adaptation for extended duration mission neutral buoyancy simulation is proposed. The advantages of using the new closed circuit rebreather gear is also reviewed and proposed as an aid to extended mission simulation. Author

N71-20241*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A METHOD TO OBTAIN AN ULTRACLEAN ENVIRONMENT
Maurice S. Gridlin and Joseph W. O'Connor *In* NBS Space Simulation Oct. 1970 p 661–668 refs (See N71-20201 09-11)
(NASA-TM-X-66944) Avail: NTIS; SOD $5.25 CSCL 14B

The vacuum techniques described find application in an Auger spectrometry system. This ionization pumped system is unconventional in that: (1) interior chamber cryogenic shrouding is eliminated. In lieu of the internal shrouds the method is to submerge the entire chamber exterior in a dewar of liquid nitrogen; and (2) the ionization pump is located within the ultrahigh vacuum chamber, rather than outside. This eliminates the gate valve typically associated with an externally mounted pump and permits greatly increased realization of the conductance pump capacity. The method of precleaning, prior to bakeout, involving high temperature gas purging is described as well as the entire systems operation. Pressures in the order of 7×10 to the minus 13th order torr have been observed. Author

N71-20242*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A PROGRAMMABLE DYNAMIC THERMAL VACUUM SYSTEM FOR SOLAR ARRAY COMPONENT TESTING
John W. Fairbanks and Marshall B. Eck *In* NBS Space Simulation Oct. 1970 p 669–682 refs (See N71-20201 09-11)
(NASA-TM-X-66945) Avail: NTIS; SOD $5.25 CSCL 14B

The programmable dynamic thermal vacuum system was designed to provide long term laboratory evaluation of solar array components undergoing thermal cyclic effects anticipated for specific missions. The equipment can obtain test specimen temperatures between +150 C to −120 C with a rate-of-change of at least 6 C/min. The facility consists of an ion pump vacuum system with 2 bell jars, thermal conditioning equipment, a 3 stage blower, a programmable control unit and an LN2 storage tank. The novel developments in this sytem include a high energy low-mass heater which employs radiative-convective coupling of a gas stream to an IR source. Author

N71-20243# Japan Oxygen Co., Ltd., Tokyo (Japan).
THE CRYOPUMPING SYSTEM FOR THE SPACE SIMULATION CHAMBER
Hiroshi Nakagawa and Ryuji Tsunoda *In* NBS Space Simulation

Oct. 1970 p 683–698 refs (See N71-20201 09-11)
Avail: SOD $5.25

A space simulation facility is described that includes a pumping system of very high pumping speed. The pumping system consists of cryopump, diffusion pump, mechanical booster pump and rotary vacuum pumps. The ultimate pressure of the order of 10 to the minus 9th power torr was achieved by this system. The pumping system consists of cryopump, sputter-ion pump and cryosorption pumps. The pumping speed of the cryopump is computed by Monte Carlo method. The dynamic performance of oil free pumping systems, especially the using order of the cryosorption pump was investigated, and the residual gases were analyzed by mass-filter. The concept of self-contamination factor is used to determine the performance of this system, and the factors of 0.006 and 0.0012 were obtained under actual operating condition. Author

N71-20244# Grumman Aerospace Corp., Bethpage, N.Y.
SIMULATION OF SURFACE ATMOSPHERE INTERACTION PROCESSES FOR MARS
K. M. Foreman *In* NBS Space Simulation Oct. 1970 p 699–723 refs (See N71-20201 09-11)
Avail: SOD $5.25

Landings of unmanned spacecraft on Mars can be affected by the effects of surface topography and soil on local atmospheric motion. A laboratory scale simulator has been designed and built to examine parameters of significance systematically. Exploratory tests of thin film sensors as wind speed indicators at simulated Mars surface pressures of 5 mb show possible difficulties in differentiating velocity from temperature at wind speeds less than several m/s magnitude. However, thin films appear quite responsive as temperature sensors to pressures on the order of less than 1 mm Hg A. Author

N71-20245# Martin Marietta Corp., Denver, Colo. Thermal Technology Section.
OPERATION OF A LARGE THERMAL VACUUM CHAMBER AT MARTIAN PRESSURE LEVELS
T. Buna and J. R. Ratliff *In* NBS Space Simulation Oct. 1970 p 725–748 refs (See N71-20201 09-11)
Avail: SOD $5.25

A test program was conducted to evaluate techniques of insulating the cold shroud of a large thermal vacuum chamber from its outer shell, in order to prevent excessive cooling of the latter during Mars environmental simulation tests. A fluidized insulation concept using polystyrene flakes in the shroud/shell interspaces was found to best meet both thermal and operational requirements. Thermal data are presented in the form of Nusselt-Rayleigh type correlations. Unique techniques devised for rapid installation and removal of the insulation are described; chamber shell temperature monitoring techniques are evaluated; and the pumpdown characteristics of the insulated chamber are established. Author

N71-20251# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
OPERATING CHARACTERISTICS OF THE AIR FORCE FLIGHT DYNAMICS LABORATORY REENTRY NOSE TIP (RENT) FACILITY
J. C. Beechler *In* NBS Space Simulation Oct. 1970 p 893–904 refs (See N71-20201 09-11)
Avail: SOD $5.25

Reentry missile nose tip development requires ground test facilities capable of simultaneously producing extreme pressures and heat transfer rates. A Reentry Nose Tip (RENT) Facility was developed to produce this high pressure hyperthermal environment. The present and planned capability of this facility is described and typical pressure and heat transfer profiles of the test jet are shown. Author

N71-20253*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MICROMETEOROID IMPACT SIMULATION SYSTEM
Robert A. Golub and John R. Davidson *In* NBS Space Simulation Oct. 1970 p 915–933 (See N71-20201 09-11)
(NASA-TM-X-66947) Avail: NTIS; SOD $5.25 CSCL 14B

A micrometeoroid impact simulation system is described and current research efforts are reported. The system electrostatically accelerates electrically charged, micrometer-size particles to velocities in excess of 30 km/s. Particles can be accelerated one at a time or at various rates to above 10/s. The major components of the system are a microparticle charger-injector, a horizontal 4-million-volt Van de Graaff accelerator, an assemblage of particle detectors, a particle deflection system, a data sysstem, and a series of target chambers. The data system is a computer controlled, real-time system which records information to determine the velocity, mass, and diameter of each particle which enters the target area. The system also controls and selects particles, and rejects particles which do not have the desired velocities. Author

N71-20425*# Sandia Corp., Albuquerque, N.Mex.
DESIGN REQUIREMENTS FOR LAMINAR AIRFLOW CLEAN ROOMS AND DEVICES
K. F. Lindell, W. J. Whitfield, and D. M. Garst May 1969 53 p refs Sponsored by NASA and AEC
(NASA-CR-116183; SC-M-69-129) Avail: NTIS CSCL 14B

The basic concept of laminar airflow and the control of airborne contamination by laminar airflow are explained. The basic design criteria are defined which are essential for the maximum performance of the various types of laminar airflow facilities which are described and illustrated. An appendix provides a list of items useful in preparing a comprehensive clean room specification. Author

N71-20549# Royal Observatory, Cape Town (South Africa).
THE ROYAL OBSERVATORY AT THE CAPE OF GOOD HOPE, 1820–1970. A SESQUICENTENNIAL OFFERING
J. D. Laing, ed. 1970 44 p
Avail: NTIS

The history of the South Africa observatory is outlined and equipment and observational programs are briefly discussed. Work in positional astronomy includes the formation of a fundamental system of star positions, an accurate geodesy, and the determination of stellar motions. The observatory's series of meterorological observations also provides time signals to the local area. G.G.

N71-20550# Joint Publications Research Service, Washington, D.C.
CLEAN ROOMS FOR PRECISION INSTRUMENT ENTERPRISES
G. P. Andreyevskiy 3 Mar. 1971 7 p Transl. into ENGLISH from Prom. Stroit. (Moscow), no. 11, Nov. 1970 p 15–18
(JPRS-52528) Avail: NTIS

Standards of vacuum electronics hygiene in a clean room require purity of the air within the limits of 70 to 350 dust particles not larger than 0.5 micron per liter; an air temperature of about 20 deg in winter and about 24 deg in summer; a relative air humidity of 50 plus or minus 10% and illumination of not less than 1000 luxes. To prevent decontamination, a definite sequence of entry into the room provides for multiple change of clothing for the worker. G.G.

N71-20590# Sandia Corp., Albuquerque, N.Mex.
MODIFIED ONE DIMENSIONAL BLAST WAVE THEORY AND EXPERIMENTAL SHOCK TRAJECTORIES FOR SHOCK TUBES WITH HIGH EXPLOSIVE DRIVERS
D. A. Freiwald May 1970 31 p refs Sponsored by AEC
(SC-RR-70-182) Avail: NTIS

Approximate one-dimensional blast wave theory was modified to account for explosive debris for the case of shock tubes with solid high explosive drivers. The theory is then compared to experimental data from several explosive shock tube tests and favorable agreement is found. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N71-19387# National Aeronautical Establishment, Ottawa (Ontario).

THE HALF CONE PRESSURE FIELD AND ITS SIGNIFICANCE TO SIDE MOUNTED INTAKES

D. J. Peake, D. J. Jones, and W. J. Rainbird *In* AGARD Aerodyn. Interference Jan. 1971 12 p refs (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

The supersonic, inviscid flow field about an isolated half cone has been computed and the result applied to a semi cone intake mounted adjacent to an aircraft fuselage. The pattern of the intake external flow was obtained from an aircraft model tested in a Mach number M = 1.6 airstream, incorporating a 25-degree semi-angle half cone. The fuselage boundary layer approaching the intake was turbulent, corresponding to a Reynolds number of 0.8 x 1 million based upon the intake capture dimension. The strong, three dimensional character of the interactions that occur between the intake shock system and the fuselage boundary layer imply that any boundary layer control system must be designed to remove the effects of three dimensional rather than two dimensional separations. Author

N71-19404*# TRW Systems Group, Redondo Beach, Calif.

MODIFIED ION PUMPED VACUUM FRICTION TEST Final Report

R. L. Hammel Feb. 1971 145 p refs Sponsored by NASA Prepared for JPL
(Contract JPL-952996)
(NASA-CR-117037; TRW-17805-6001-R0-00) Avail: NTIS CSCL 20D

A set of boundary layer friction data was generated for sixteen material couples sliding in an ion pumped vacuum which was modified by the controlled introduction of six gases. The six gases used for this study were argon, carbon dioxide, methane, nitrogen, oxygen and water. Sliding friction data were taken under vacuum and at higher pressure levels while leaking in each of the test gases. These data are compared to previous orbital and other ground test vacuum friction data taken with the same test hardware and materials. Use of a mass spectrometer to characterize the vacuum composition permitted an assessment of the pumping selectivity of electronic vacuum pumps. General friction behavior was comparable to the orbital and previous molecular sink and ion pumped friction data. In two material pairs, the maximum friction force attained appears controlled by the gas introduction. Selective influence of particular gas introductions was noted for two additional pairs. Other comparative data suggest the quantities and species used had little controlling influence on the frictional behavior of the remaining pairs. Author

N71-19408# Massachusetts Inst. of Tech., Cambridge. Hydrodynamics Lab.

NUMERICAL SOLUTION OF UNSTEADY FLOWS IN OPEN CHANNELS

Daniel J. Gunaratnam and Frank E. Perkins Jul. 1970 262 p refs
(Contracts DI-14-01-0001-1988; DI-14-31-0001-3159)
(PB-196159; R70-44; DSR-71934; Rept-127) Avail: NTIS CSCL 20D

A finite difference scheme was developed to integrate the St. Venant equations over a wide range of transient flow conditons. The scheme was incorporated into a useful computer program. Systematic testing compared the difference scheme with observed data and linearized analytical solutions. The weighted residual method using the Galerikan technique of minimizing proved to be a relatively simple method for deriving a minimum error finite difference scheme. Solution of the set of simultaneous algebraic equations generated by the implicit difference scheme was effected using the influence function method. This provides a very efficient procedure for solving the equations associated with a network of channels. GRA

N71-19423# Nagoya Univ. (Japan). Inst. of Plasma Physics.

LOCAL POTENTIAL AND SHOCK WAVES

T. Fujita (Kansai Univ.), T. Koda (Osaka Univ.), and Y. Watanabe (Osaka Univ.) Nov. 1970 17 p refs
(IPPJ-101) Avail: NTIS

By using the local potential of the Boltzmann-type equations, the most reasonable profile equation is derived on the basis of the minimal entropy rate principle postulated for stationary irreversible processes. The profile equation is a sort of moment equation containing a number of variational parameters. The ambiguities included in the conventional moment theories are removed. As one example, Mott-Smith's model is examined as a trial function, which reduces the steadiness of shock waves for the strong cases. Author

N71-19487# Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

FLOWFIELD SURVEYS IN THE HYPERSONIC VISCOUS SHOCK LAYER ON A SHARP FLAT PLATE

Robert J. Vidal, John A. Bartz, and Gordon E. Merritt Sep. 1970 19 p refs
(Contract F44620-70-C-0039)
(AD-716485; CAL-AF-2919-A-1; AFOSR-70-2499TR) Avail: NTIS CSCL 20/4

Flowfield surveys were obtained in the hypersonic viscous shock layer on a sharp flat plate with probes measuring the local molecular speed-ratio and local values of the product of density, velocity, and total enthalpy. The data define a disturbance boundary upstream of the leading edge where compression effects first begin, and a boundary within the shock layer where viscous heating effects begin to dominate over the compression effects. Author (GRA)

N71-19496 Tennessee Univ., Knoxville.

ON SOME ASPECTS OF SHOCK WAVE OSCILLATIONS IN SUPERSONIC DIFFUSERS

Dieter Jacob (Ph.D. Thesis) 1969 159 p
Avail: Univ. Microfilms: HC $7.40/Microfilm $3.00 Order No. 70-2115

Literature pertinent to the oscillating interaction of shock waves and turbulent boundary layers is critically reviewed. The unsteady interaction of harmonic upstream or downstream disturbances with normal shock waves in nonviscous, quasi-one-dimensional diffuser flow is treated. A numerical method is presented which applies to arbitrary diffuser shapes. Solutions for different exit conditions and upstream disturbances are discussed. Dissert. Abstr.

N71-19542# Wisconsin Univ., Madison. Mathematics Research Center.

ASYMPTOTIC NONLINEAR WAVE MOTION OF A VISCOUS FLUID IN AN INCLINED CHANNEL OF ARBITRARY CROSS SECTION

M. C. Shen and S. M. Shih Feb. 1970 33 p refs Sponsored in part by Dept. of Interior
(Contract DA-31-124-ARO(D)-462)
(AD-715958; MRC-TSE-1047) Avail: NTIS CSCL 20/4

A tractable asymptotic theory is achieved for the study of three-dimensional nonlinear wave motion of an incompressible, viscous fluid with surface tension in an inclined channel of arbitrary cross section. The method developed here is based upon a multiple-parameter singular perturbation scheme within the framework of long-wave approximation. The nonlinear problem is reduced to a sequence of linear elliptic mixed boundary-value problems, which can be solved by means of standard methods. These solutions are then used to determine the wave speed and evolution equations governing the nonlinear wave motion. The results obtained give a quantitative description of a three-dimensional bore structure in an inclined channel of arbitrary cross section, and critical Reynolds number is also defined as a criterion for the instability of the wave motion. Author (GRA)

N71-19555# Ballistic Research Labs., Aberdeen Proving Ground, Md.
GAS FLOW DURING AND AFTER THE DEFLAGRATION OF A SPHERICAL CLOUD OF FUEL-AIR MIXTURE
Abdul R. Kiwan Nov. 1970 28 p refs
(AD-716339; BRL-1511) Avail: NTIS CSCL 20/4

Properties of the flow resulting from the deflagration of a spherical cloud of fuel-air mixture are studied in two stages. A similarity solution is assumed for the flow during the combustion process. A finite difference solution is computed for the flow after the combustion process ends. Author (GRA)

N71-19607# Minnesota Univ., Minneapolis. Heat Transfer Lab.
NUMERICAL SOLUTION OF TURBULENT ANNULAR SWIRL FLOWS Final Report
Claus J. Boerner Jul. 1970 99 p refs
(Contract DAHC04-67-C-0021)
(AD-716450; HTL-93; AROD-6612-3-E) Avail: NTIS CSCL 20/4

The time averaged Navier-Stokes equations for quasi-steady, axisymmetric, incompressible turbulent flow were solved for an annular geometry. The effects of turbulent interactions are incorporated through the use of two apparent turbulent viscosities which are computed separately for the axial and the tangential momentum equation. Several equations are tested which link the apparent turbulent viscosity in the tangential momentum equation to the tangential velocity profile at each axial location. Best results, as measured by the agreement with experimental data, were obtained with a model that links the viscosity to the tangential velocity via the average flow angle, the wall shear velocity, and the distance of the zero shear location normal to the wall. For four different nominal flow angles at the inlet cross section, the numerical solutions were obtained. Comparisons with experimental data were possible at seven axial locations. The agreement was satisfactory to good in all cases. Author (GRA)

N71-19608# Minnesota Univ., Minneapolis. Heat Transfer Lab.
DECAY OF TURBULENT SWIRL IN AN ANNULAR DUCT Final Report
Dean R. Rask and Charles T. Scott Jun. 1970 125 p refs
(Contract DAHC04-67-C-0021)
(AD-716452; HTL-963-AROD-6612-4-E) Avail: NTIS CSCL 20/4

An experimental investigation was carried out to determine fluid dynamic properties of turbulent vortex flows; i.e., flows with both tangential and axial mean velocities, in a concentric annular duct. The working fluid was air and the flow was incompressible. All measurements were made at a nominal Reynolds number of 130,000. The average axial velocity was on the order of 90 ft/sec. Measurements were made with both a cylindrical pressure probe and a hot film probe. The swirl imparted to the flow in the inlet decayed as the flow moved down the test section. Extensive surveys of the velocity field were made for five different swirl rates with one of the swirl rates being that of zero swirl or straight flow. The term swirl rate refers to the relative magnitude of the inlet tangential velocity. Local axial skin-friction coefficients at the inner wall were determined at seven different axial locations for all five swirl rates. For the swirl rates tested, no regular shift in the skin-friction distribution is noted with increasing swirl rate except at the highest swirl rate where the distribution is considerably below the others. At the inner wall, axial velocity profiles were also presented in terms of law-of-the-wall variables. Good to relatively poor agreement with the universal velocity-distribution was achieved. Author (GRA)

N71-19609# Royal Aircraft Establishment, Farnborough (England).
HOW IS A VORTEX FORMED IN A FLUID OF SMALL VISCOSITY [WIE ENSTEHT EIN WIRBEL IN EINER WENIG ZAEHEN FLUESSIGKEIT]
A. Betz Jul. 1970 12 p refs Transl. into ENGLISH from Die Naturwissenschaften (West Ger.), v. 37, no. 9, 1950 p 193–196
(RAE-Lib-Trans-1466; BR22694) Avail: NTIS

It is shown that a strong vortex with circular cross-section cannot be directly generated in a fluid of small viscosity. Instead such vortices arise by a rolling-up process out of thin vortex sheets. The latter can be generated in fluids with small viscosity and quickly develop (by rolling up) into vortex cores of a size which corresponds to the energy available and conforms to the observations. Author

N71-19613# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF THE STAGGERED DIFFUSER
Yu N. Vasilev 14 Oct. 1970 28 p refs Transl. into ENGLISH from Lopatochnye Mashiny i Struynye Apparaty (Moscow), no. 4, 1969 p 229–245
(AD-716505; FTD-HC-23-459-70) Avail: NTIS CSCL 20/4

In order to check the flow of a liquid or gas moving at subsonic velocity, diffusers with constantly increasing (in the direction of the output) cross-sections are usually employed. Most frequently, diffusers are of conical design with opening angle of 8-10 degrees. In such devices pressure drop is mainly due to friction with the walls. In certain cases, however, the use of a diffuser of this design is impossible for one reason or another, and retardation of the flow must be achieved by a sudden increase in cross-sectional area. In such cases the jet is diverted from the walls and from the butt end of the channel which joins the tube, and in this way a stagnant region appears. Flow in such diffusers is characterized by intensive eddies, which result from great pressure drops. The paper is devoted to a type of staggered diffuser in which the flow encounters several sudden increases in cross-section. Author (GRA)

N71-19614# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
A PRELIMINARY STUDY OF SPHERICAL DETONATION: WAVE SYMMETRY IN STOICHIOMETRIC HYDROGEN-OXYGEN MIXTURES
A. K. MacPherson Feb. 1970 15 p refs
(Contract AF 33(615)-5313)
(AD-716348; UTIAS-TN-154) Avail: NTIS CSCL 20/4

A photographic study was undertaken of the detonation wave produced in a hemispherical chamber filled with a H_2-O_2 mixture at high initial pressures (600 psi). The study was directed at the driving processes in the driver of the UTIAS Implosion-Driven Hypervelocity Launcher. The shape of the luminous front of hemispherical detonation waves were photographed for waves produced in stoichiometric hydrogen-oxygen mixtures at initial pressure of between 7 and 27 atmospheres. It was found that the

wave pictures were not reproducible when tests were performed under apparently identical conditions. Further, the wave front was not always smooth and often asymmetrical. Author (GRA)

N71-19617# National Aeronautical Establishment, Ottawa (Ontario).

COMPARISON OF SEVERAL MIXING LENGTH MODELS FOR TURBULENT BOUNDARY LAYER COMPUTATIONS

Y. Y. Chan Mar. 1970 49 p refs

(NRC-11708; LR-531) Avail: NTIS

A computational method for turbulent boundary layers in an incompressible two-dimensional flow was formulated. The governing differential equations for the mean flow are solved by an implicit finite difference method. The Reynolds shear stress is correlated by Prandtl's mixing length concept. Four models of correlation for the mixing length are studied and prediction based on these models is assessed by comparison with several sets of experimental data. It is found that models correlated only to local mean flow cannot adjust themselves to the proper turbulent state for highly nonequilibrium flow. If the turbulent state is considered explicitly by computing the mixing length from the turbulent energy equation, the results show excellent agreement with experimental data. Author

N71-19618# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.

HYDRODYNAMICS OF ARTERIAL STENOSES: A REVIEW

Donald F. Young Jun. 1970 38 p refs

(Contract PHS-HE-11717)

(PB-193172; ERI-77300) Avail: NTIS CSCL 06P

Flow characteristics are considered in a constricted tube with special attention given to those characteristics which may have significance in the study of arterial stenoses. Applicable fluid mechanics equations and approximations are discussed and a review of previous work related to this problem is given. Author (GRA)

N71-19629# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

QUESTIONS OF PNEUMONICS (FLUID FLOW PNEUMOAUTOMATION)

L. A. Zalmanzon 26 Oct. 1970 20 p refs Transl. into ENGLISH from Proceedings of 3rd Vses. Soveshch. po Avtomat. Komu Upr. Tekhn. Kibernetike, Tekhn. Sredstva Avtomat. Tr., (Odessa), 1967 p 26-35

(AD-716519; FTD-HC-23-1445-68) Avail: NTIS CSCL 13/7

Some general problems of determining the characteristics of jet elements are considered, with emphasis on elements whose operation is based on the simple effect jet interaction in the presence of turbulent flow in both the supply and control channels, and elements in which the flow in the supply channels is turbulent and in the control channels laminar. In the first case it is assumed that the channels have a rectangular cross section and that the jets interact between the parallel walls. In the second case it is assumed that the laminar jet issuing from the given channel consists of a countless number of elementary jets. Expressions are derived describing the dependence of the angle of deflection of the main jet, flow velocity, and gage pressures of the velocity head at various points of the cross section of the resulting jet on control and supply pressures and other quantities determining the operation of the jet element. In addition, deflection of a jet by another jet in the presence of turbulent flow in both channels was studied experimentally. Author (GRA)

N71-19635# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.

BALANCE MEASURED THRUST PERFORMANCE OF VARIOUS COWLED AXIAL FAN CONFIGURATIONS IN A MAINSTREAM AT 90 DEG INCIDENCE

R. A. Tyler and R. G. Williamson Oct. 1970 155 p refs

(NRC-11740; LR-543) Avail: NTIS

Balance measured force data are presented for a series of thrusting fan configurations (tip dia 15 in) operated in crossflow, at 90 deg incidence, in the 10 ft. x 20 ft NRC V/STOL Propulsion Tunnel. Test conditions involved tunnel speeds from 30 to 130 ft/sec in combination with mean intake velocities from 100 to 400 ft/sec. The force data provide a direct measure of fan gross thrust performance at constant fan speed, under conditions of increasing forward speed, i.e. increasing inflow distortion. Limited pressure data afford an indication of the behavior of overall fan pressure ratio under the same conditions. A total of 51 different configurations was tested, providing some insight into the effects of various configurational variables on thrust performance sensitivity to cross-flow conditions. Author

N71-19637*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

PENETRATION AND SPREADING OF TRANSVERSE JETS OF HYDROGEN IN A MACH 2.72 AIRSTREAM

John P. Wagner, James M. Cameron, and Frederick S. Billig Washington NASA Mar. 1971 45 p refs

(Contract NASr-76)

(NASA-CR-1794) Avail: NTIS CSCL 20D

Hydrogen was injected from a flat-plate model (simulating the wall of a supersonic combustor) into a Mach 2.72 air stream. The transverse, sonic, underexpanded-jet injection was either from a single port or from a five-port injector having the same total throat (exit) area, with a 3-diameter center-to-center spacing. The latter injector was tested with the row of ports either aligned with or perpendicular to the mainstream flow direction. Schlieren photographs, cone-static and pitot pressure surveys, and gas-sampling surveys were used to define in detail the complex flow field. In the y-z (normal) plane at the downstream (x) station 5 equivalent-single-port diameters from the injector, the effective cross-sectional area of fuel distribution achieved with the aligned multiport injector was approximately 22% greater than that for the perpendicular multiport injector and approximately 7% greater than that for the single port. Author

N71-19656# Naval Ordnance Lab., White Oak, Md.

FLOW VISUALIZATION STUDIES OF A FIN PROTUBERANCE PARTIALLY IMMERSED IN A TURBULENT BOUNDARY LAYER AT MACH 5

Allen E. Winkelmann 20 May 1970 56 p refs

(AD-716023; NOLTR-70-93) Avail: NTIS CSCL 20/4

Various flow visualization results are presented for a cylindrically blunted, unswept fin (yawed and unyawed) partially immersed in a turbulent boundary layer (sigma approximates 2.6 inches). The model, consisting of a fin-flat plate combination, was mounted on the test plate nozzle wall of a boundary layer channel. Experiments were completed at a nominal Mach number of 5 and nominal free stream Reynolds numbers per foot of 2.8 x 10 to the 6th power and 7.4 x 10 to the 6th power. Azobenzene tests show regions of high heat transfer to occur on the flat plate immediately upstream and downstream of the fin. Oil smear tests show in detail the surface shear directions and locations of separated flow which occur on the model. Schlieren and shadowgraph photographs indicate the complex shock wave structure which exists in front of the fin. A possible flow field model is suggested to account for the observed flow patterns. Author

N71-19666# Applicazioni e Ricerche Scientifiche, Milan (Italy).

KINETIC THEORY AND GAS SURFACE INTERACTIONS: AN INTERESTING INTERFACE Summary Scientific Report, 1 Aug. 1969 - 31 Jul. 1970

Carlo Cercignani 31 Jul. 1970 12 p refs

(Contract F6052-68-C-0020)

(AD-716572; AFOSR-70-2860TR) Avail: NTIS CSCL 7/4

The report summarizes work done in the field of rarefied gas dynamics. The main emphasis was on an aspect which is beginning to receive much more attention than in the past, i.e. the mutual relationships between the fields of gas surface interactions and kinetic theory. The recent work done in this area is reviewed and possible developments are pointed out. Author (GRA)

N71-19670# Aerospace Corp., El Segundo, Calif. Lab. Operations.
INTERPRETATION OF DENSITY-GAUGE DATA FOR SUPERSONIC GAS FLOW
Michael Schulz and David D. Elliott 18 Dec. 1970 18 p refs
(Contract F04701-70-C-0059)
(AD-716618; TR-0059(6260-20)-12; SAMSO-TR-70-429) Avail: NTIS CSCL 14/2

When a collisionless neutral gas rams supersonically into an ionization gauge of conventional design, the density inside the gauge exceeds that in the ambient. The gauge is assumed to be separated from the ambient by a partially accessible cylindrical chamber of length L radius r. Author (GRA)

N71-19684# Naval Ordnance Lab., White Oak, Md.
CALCULATION OF LAMINAR SKIN FRICTION ON A POROUS PLATE BY A REFINED INTEGRAL METHOD
Tse-Fou Zien 10 Aug. 1970 33 p refs
(AD-716035; NOLTR-70-148) Avail: NTIS CSCL 20/4

The skin friction on a porous flat plate in the presence of an incompressible laminar boundary layer is calculated by a generalization of a refined integral technique. This method is based on a double integration of the momentum equation, replacing the skin-friction term by an integral representation involving the assumed velocity profile. Both a case of similarity blowing of suction and a case of uniform blowing or suction were studied. Using two simple and crude velocity profiles of polynominal form with constant coefficients, closed-form solutions are obtained through simple procedures and compared with the available exact solutions. The same profiles are then employed in the usual integral method to calculate the corresponding skin friction. Author (GRA)

N71-19713# Hydronautics, Inc., Laurel, Md.
EFFECTS OF HYDRODYNAMIC PARAMETERS ON CAVITATION EROSION INTENSITY
A. Thiruvengadam Nov. 1970 59 p refs
(Contract N00014-70-C-0204)
(AD-716053; TR-233-14) Avail: NTIS CSCL 20/4

A rotating foil apparatus was developed and used to study the effect of exposure time, pressure, velocity and size of the foil on intensity of cavitation erosion. Earlier studies with a vibratory apparatus showed that the rate of erosion increases with exposure time, reaches a maximum value and then decreases. These observations are essentially confirmed for the case of erosion on an actual hydrofoil. The maximum rate of erosion is then correlated with the cavitation parameter for two sizes of NACA 16-021 hydrofoil (3 inches and 1 1/2 inches in chord length). The intensity of erosion increases with decreasing cavitation parameter, reaches a peak and then decreases with decreasing cavitation parameter at a given velocity. An approximate analysis was made to explain this result. According to this analysis, the intensity of erosion should vary as the cube of the velocity and should be independent of the size of the foil. However, the experimental results show that the intensity of erosion varies as the sixth power of the velocity and also depends on the size of the foil. An understanding of these two scale effects is essential for successful model-prototype correlation. Author (GRA)

N71-19760# National Aerospace Lab., Tokyo (Japan).
BENDING AND DEVELOPMENT OF THREE DIMENSIONAL TURBULENT JETS IN A CROSS WIND
Hiroshi Endo and Masayoshi Nakamura Nov. 1970 25 p refs In JAPANESE; ENGLISH summary
NAL-TR-216) Avail: NTIS

A semiempirical theory on the bending and the development of a round turbulent jet in a subsonic cross wind is presented. Theoretical model of the dynamical interaction between the jet and the external flow is formulated by unifying the entrainment model and the vortex sheet model. One of the characteristics of this model is the introduction of the entrainment function E taking into account the inward flow into the jet of the external air induced by a pair of concentrated vortices on the rear side of the jet. The mass inflow rate is related to the moment micron of the vortex-doublet which is an idealized representation of the intensity of the vortex pair and can be obtained by means of the vortex sheet concept. Thus, the path, the spread of width and decay in the velocity of the jet, and also the development of the vortex-doublet can be determined by solving a system of equations for the arbitrary values of the jet exit velocity and incidence angle. Author

N71-19761# National Aerospace Lab., Tokyo (Japan).
SUPERSONIC FLOW FIELDS AROUND A CYLINDRICAL BODY WITH A BLUNT NOSE
Iwao Kawamoto Jun. 1970 27 p refs In JAPANESE; ENGLISH summary
(NAL-TR-199) Avail: NTIS

An extremely high-speed vehicle with blunt nose causes a nonuniform flow field normal to the body axis by virtue of a strong bow shock. The nonuniformity remains far down the nose and particularly near the body surface. It is assumed that if the fluid is inviscid and adiabatic, the total pressure after being reduced across the shock, is conserved along a streamline, and has a certain profile in distribution normal to the body axis. This flow field at supersonic speed of vehicles, such as large rockets, is investigated by numerical, experimental, and simplified theoretical methods. Author

N71-19762# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
GAS PARTICLE SUSPENSION PROPERTIES ON A BLADE TO BLADE STREAM SURFACE OF A CASCADE NOZZLE
M. Hussein and W. Tabakoff Dec. 1970 49 p refs
(Contract DAHC04-69-C-0016; Proj. Themis)
(AD-715971; THEMIS-AE-70-17) Avail: NTIS CSCL 20/4

The gas-particle flow properties, namely flow pressure, gas and particles velocities and temperatures, were calculated theoretically in a blade to blade stream surface of a cascade nozzle. The effects of the particle concentration, mean diameter and material density on the flow properties at any point in the cascade nozzle were investigated. Author (GRA)

N71-19764*# Mechanical Technology, Inc., Latham, N.Y. Research and Development Div.
DYNAMICAL ANALYSIS OF NON-EQUILIBRIUM FORCED CONVECTIVE BOILING FLOWS
C. H. T. Pan and J. H. Vohr Dec. 1970 55 p refs
(Contract NASw-1705)
(NASA-CR-117034; MTI-70TR16) Avail: NTIS CSCL 20D

The results are presented of a two phase program directed toward obtaining solutions for the thermo-hydraulic liquid metal boiler stability problem. The first phase of the investigation was concerned with the prediction of incipient boiling. The principle premise of the study attributes the boiling nucleation process to be dominated by sites present on the boiler walls as surface cavities. The need of superheating to initiate nucleation is presumed to be the requirement for a pressure excess above the saturation vapor pressure in the cavities to overcome the surface tension of the liquid. The second phase of the investigation was concerned with the determination of vaporization rates for each of the various flow regimes. Emphasis was placed on the release of liquid superheat with the attendant generation of the vapor phase, since the

pressure rise would be a principle driving force for the dynamic motion in a thermo-hydraulic system. The specific analyses on various mechanisms of evaporation are then recast in terms of a vapor generation rate which represents the constitutive relation of the evaporative process. D.L.G.

N71-19830 Aerospace Research Labs., Wright-Patterson AFB, Ohio. Hypersonic Research Lab.

PROCEEDINGS OF THE 1969 SYMPOSIUM ON VISCOUS INTERACTION PHENOMENA IN SUPERSONIC AND HYPERSONIC FLOW

1970 560 p refs Symp. held at Wright-Patterson AFB, Ohio, 7-May 1969

(AD-714362) Avail: HC available no charge from Issuing Activity, Attn: Maj. Morton, Bldg. 450, Wright-Patterson AFB, Ohio 45433. No copies furnished by DDC or NTIS CSCL 20/4

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N71-19831*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SOME RECENT RESEARCH WITH VISCOUS INTERACTING FLOW IN HYPERSONIC STREAMS

Mitchel H. Bertram and Arthur Henderson, Jr. *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 1-30 refs (See N71-19830 09-12)

(NASA-TM-X-66914) Avail: NTIS CSCL 20D

Experiments are reviewed in which viscous interaction and interference predominate. This includes research on flaps at low Reynolds numbers, the flow in corners, and the flow over delta wings at high Reynolds numbers and with the addition of a body. Heat transfer and pitot and surface pressure distributions, oil flow, and the electron beam flow visualization technique are used to examine several of these interacting flow fields. Author

N71-19832*# Nielsen Engineering and Research, Inc., Palo Alto, Calif.

REVIEW OF THE METHOD OF INTEGRAL RELATIONS APPLIED TO VISCOUS INTERACTION PROBLEMS INCLUDING SEPARATION

Jack N. Nielsen, Frederick K. Goodwin, and Gary D. Kuhn *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 31-82 refs Sponsored in part by NASA and AFFDL (See N71-19830 09-12)

(NASA-CR-117051) Avail: NTIS CSCL 20D

The method of integral relations is described with emphasis on the physical and mathematical principles underlying the method. The following applications of the method are discussed: (1) laminar boundary layers on plate-wedge combinations, (2) laminar boundary-layer, shock-wave interaction, (3) critical temperature ratio (4) supersonic laminar flow over rectangular cavities, (5) axisymmetric supersonic laminar separation on a curved compression flare, (6) unseparated turbulent boundary layers on flat plates and axisymmetric compression surfaces, and (7) turbulent boundary-layer, shock-wave interaction. Author

N71-19833 Princeton Univ., N.J. Gas Dynamics Lab.

THE LAMINAR HYPERSONIC BOUNDARY LAYER: SOME OBSERVATIONS OF THE LEADING AND TRAILING EDGE PROBLEM

S. M. Bogdonoff *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 83-108 refs (See N71-19830 09-12)

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The limits of applicability of classical strong and weak hypersonic interaction theory were investigated near the leading edge and trailing edges of bodies in high-speed flows. The influence of the leading edge region was found to extend considerably downstream of the merged region. An adjustment region, extending to hypersonic interaction parameters of approximately 50 and rarefaction parameters less than 0.1, is proposed before complete reliance on hypersonic strong interaction theories is realistic. Upstream influence from the trailing edge base flow or small surface disturbances extend many boundary layer thicknesses at low Mach number and at adiabatic wall conditions but only a fraction of a boundary layer thickness at high Mach number and cold wall conditions. Correlation of the results was obtained on a boundary layer to subsonic layer thickness ratio, but further tests and

analysis are required to complete the understanding of this flow phenomenon. Author

N71-19834*# McDonnell-Douglas Astronautics Co., Santa Monica, Calif. Western Div.

SUPERSONIC TURBULENT BOUNDARY LAYER INTERACTION WITH A COMPRESSION CORNER AT VERY HIGH REYNOLDS NUMBER

A. Roshko and G. J. Thomke *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 109–138 refs (See N71-19830 09-12)

(Contract NAS9-589)

(NASA-CR-117052) Avail: NTIS CSCL 20D

Shock wave boundary layer interaction in supersonic flow over a compression corner was investigated. The concern is more with the conditions for incipient separation, and those before separation, than with the oft-studied case of fully separated flow. The boundary layer is turbulent and at very high Reynolds numbers, which was made possible by utilizing the thick turbulent boundary layer on the wall of a large wind tunnel. The compression corner consisted of a ramp whose inclination could be varied and set during a run; this feature made it feasible to vary easily the conditions leading to incipient separation. Author

N71-19835 Avco Corp., Wilmington, Mass. Systems Div.

TURBULENT BOUNDARY LAYER SEPARATION AND REATTACHMENT AT SUPERSONIC AND HYPERSONIC SPEEDS

A. Todisco and B. L. Reeves *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic flow 1970 p 139–179 refs (See N71-19830 09-12)

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An experimental and theoretical investigation of turbulent separated and reattaching flows on a flat plate-compression corner is described. The experiments were conducted at Mach 6.5. The model was a compression wedge attached to the trailing edge of a flat plate. The results show an interaction between separation and the natural transition location for Reynolds numbers based on plate length less than 0.000003. Below this Reynolds number, the layer was tripped by separation near the leading edge, resulting in Reynolds numbers at transition less than half the natural flat plate value. For fully turbulent separation, the measured plateau pressure was independent of Reynolds number. Heat transfer rates on the wedge were found to be as high as forty times the turbulent flat plate value. The theoretical analysis shows how the moment integral method can be used for turbulent separated and reattaching boundary layers in which there is a strong interaction with the outer inviscid flow. Author

N71-19836 Imperial Coll. of Science and Technology, London (England). Dept. of Aeronautics.

HYPERSONIC VISCOUS FLOW OVER CONCAVE AND CONVEX SURFACES

J. L. Stollery *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 181–212 refs (See N71-19830 09-12)

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Experimental and theoretical studies of hypersonic laminar boundary layer growth over curved surfaces were made to study the effects of Reynolds number, Mach number, wall temperature, and viscous interaction on surface pressure and heat transfer rate distributions, boundary layer thickness, and separation point position. Experiments were made at M = 8, 12, and 15 on continuous concave and convex surfaces and on a flat plate with variable trailing edge flap. On the last of these models it was possible to study attached incipient, and well-separated flows. The incipient separation data were compared with other laminar results. By changing the tunnel conditions, the magnitude of the viscous interaction effects was varied and the influence on surface pressure and heat transfer rate ascertained. By heating the model, the effect of wall temperature ratio was clearly demonstrated: the colder the wall, the further separation was delayed. Author

N71-19837 Cornell Aeronautical Lab., Inc., Buffalo, N.Y.

THEORETICAL AND EXPERIMENTAL STUDIES OF THE SHOCK WAVE BOUNDARY INTERACTION ON CURVED COMPRESSION SURFACES

Michael S. Holden *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 213–270 refs (See N71-19830 09-12)

(Contract F33615-67-C-1298)

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A theoretical and experimental study of attached and separated laminar boundary layers over highly cooled, curved compression surfaces in a hypersonic airflow is described. In the theoretical study, the integral forms of the boundary-layer equations for the conservation of mass, streamwise momentum, normal momentum, moment of streamwise momentum, and energy were used to describe the development of attached and separated boundary layers on a curved surface. The theory, which was in good agreement with measurements on compression surfaces in Mach 10 and 14.8 airflows, showed that large pressure gradients can be generated across the boundary layer in the separation and reattachment regions. In the experimental study, skin friction, heat transfer and pressure measurements were made on a series of flat plate-cylindrical arc-wedge compression surfaces. Separation first occurred on the compression surface downstream of the flat plate, and incipient separation could not always be detected by observing the first occurrence of an inflexion point in the pressure distribution. Author

N71-19838 New York Univ., N.Y.

VISCOUS FLOW AT HIGH MACH NUMBERS WITH PRESSURE GRADIENTS

Antonio Ferri and Sanford Dash *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 271–317 refs (See N71-19830 09-12)

(Contract Nonr-285(63))

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A numerical method for the analysis of axisymmetric or two-dimensional viscous supersonic flows is presented. The method is applied to the analysis of the flow fields near two-dimensional curved walls at hypersonic speed. Such examples show that at hypersonic velocity, the pressure gradients along the streamlines induce large pressure gradients normal to the streamlines that cannot be accounted for by the classical boundary-layer analysis. Such interaction affects the flow outside the boundary layer. Author

N71-19839 General Electric Co., Philadelphia, Pa. Space Sciences Lab.

SOLUTION OF THE NAVIER-STOKES EQUATIONS FOR VISCOUS SUPERSONIC FLOWS ADJACENT TO ISOTHERMAL AND ADIABATIC SURFACES

Sinclaire M. Scala and Paul Gordon *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 319–391 refs (See N71-19830 09-12)

(Contract N00014-68-C-0404)

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A method is being developed for the calculation of complete flow fields which is based on the numerical solution of the complete time-dependent Navier-Stokes equations. Details are presented of the procedure for a number of geometries, including one-dimensional (the piston problem), two-dimensional (flow around a circular cylinder) and axially-symmetric (flow around an isothermal sphere) cases. The gas was treated as a perfect, diatomic, nondissociating, viscous, thermally conducting gas. At the surface in contact with the fluid, the two limiting boundary conditions for surface temperature are utilized, i.e., the low temperature limit corresponding to an isothermal wall (high heat transfer rate) and the high temperature limit corresponding to the adiabatic wall (zero heat transfer rate). The time-dependent structure of the flow field, including the velocity profiles, the density, temperature and pressure distributions, is presented for each of the aforementioned geometries for a range of Reynolds numbers. Author

N71-19840 Applied Theory, Santa Monica, Calif.

NUMERICAL CALCULATIONS OF SEPARATED FLOWS

J. G. Trulio, L. Walitt, and C. Y. Liu (Calif. Univ., Los Angeles) *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 393–425 refs (See N71-19830 09-12)

(Contract DAAG07-69-C-0101)

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The application to a case of separated flow of a numerical method for the solution of continuum motion problems (and more generally for the calculation of classical fields) is discussed. The method is an extension and modification of the early work of von Neumann and Richtmyer; it is applicable in principle to all branches of continuum mechanics. Specific finite difference equations implied by the numerical method have been made on the basis of a set of AFTON computer codes. Here, the chief tool used was the AFTON 2P code. The problem considered was that of two-dimensional plane flow around a right circular cylinder at M = 2 and R = 1,409, based on cylinder diameter and free stream flow speed. Author

N71-19841 General Electric Co., Philadelphia, Pa. Space Sciences Lab.

THE AXIALLY SYMMETRIC THROAT PHENOMENON IN INTERACTING VISCOUS-INVISCID FLOWS

R. W. Garvine and S. Weinbaum (City Univ. of New York) *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 427–461 refs (See N71-19830 09-12)

(Contract N00014-68-C-0169)

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Planar two-dimensional laminar wake throat theory is extended to axially-symmetric supersonic wakes. The theory is based on an exact treatment of the compressible boundary-layer equations for an axially-symmetric shear layer and a linearized description of the inviscid outer flow. The analysis is more complicated than that of the planar case because of transverse curvature effects and the importance of waves of both families in the outer flow. The sensitivity of the throat profiles to the size and shape of the entrained flow region is explored. The wake throat in all cases studied occurs in a region of adverse pressure gradient. Numerical solutions for the pressure gradient at the throat station for wake profiles satisfying the throat constraint are presented for a wide range of Mach and Reynolds numbers. Author

N71-19842 Ohio State Univ., Columbus.

COMPUTATION OF SEPARATED FLOW OVER BACKWARD FACING STEPS AT HIGH REYNOLDS NUMBER

Odus R. Burggraf *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 463–491 refs (See N71-19830 09-12)

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The problem of laminar separated flow over a backward-facing step is solved numerically for the limiting case of infinite Reynolds number. The flow model is for incompressible flow. The boundary layer equations are simplified by a Dorodnitsyn transformation and numerically solved using an implicit finite difference procedure. The interaction between the inviscid eddy and recirculating shear layer is treated by iteration, with the first approximation corresponding to a constant pressure eddy. Solutions were obtained showing the effect of initial external boundary-layer profile (at the separation point) and Mach number of the external flow. Velocity profiles are presented, as well as pressure and heat transfer distributions along the wall. Author

N71-19843 Polytechnic Inst. of Brooklyn, N.Y.

THREE DIMENSIONAL VISCOUS INTERACTIONS

M. H. Bloom, S. G. Rubin, and R. J. Cresci *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 493–522 refs (See N71-19830 09-12)

(Contract AF 49(683)-1623)

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Results of analysis and experiment on three-dimensional effects in hypersonic interaction are presented with emphasis on a sharp-edged rectangular corner intersection aligned with the flow and a sharp-edged plate of finite span. A powerful tool for dealing with such complex problems is the "merged-layer approximation" which obviates the need for complicated matching procedures in many instances of importance, although numerical computation is required. This type of flow, in which various elements are strongly coupled and even merged, is shown to have features in common with low-speed three-dimensional boundary layers such as those along an interior corner or along the edge of a quarter-infinite plate. In the low-speed cases the essential viscous-inviscid interaction coupling enters through the weak, Reynolds-number dependent, displacements of the inviscid flow which must be taken into account even to lowest order. Author

N71-19844 von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).

HIGH SPEED FLOWS OVER WEDGES AND FLARES WITH EMPHASIS ON A METHOD OF DETECTING TRANSITION

Jean J. Ginoux *In* ARL Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 523–549 refs Prepared in cooperation with Brussels Univ. (See N71-19830 09-12)

Avail: HC available no charge from Issuing Activity. Attn: Maj. Morton, Bldg. 450, Wright-Patterson AFB, Ohio 45433. No copies furnished by DDC or NTIS

Static pressure distributions were measured in separated flows over adiabatic flaps and flares at Mach numbers of 2.25 and 5.3. They show the effect of free stream unit Reynolds number in the laminar and transitional cases. A method of accurately detecting the presence of transition in the reattachment region was developed and the effect on transition of roughness elements located upstream of separation was studied. Author

N71-19845 Aerospace Research Labs., Wright-Patterson AFB, Ohio.

AN INVESTIGATION OF THE EXTENT OF LAMINAR TWO DIMENSIONAL BOUNDARY LAYER SEPARATION AT MODERATELY HYPERSONIC SPEEDS

Karlheinz O. W. Ball *In its* Proc. of the 1969 Symp. on Viscous Interaction Phenomena in Supersonic and Hypersonic Flow 1970 p 551–566 refs (See N71-19830 09-12)

(Contract AF 33(615)-2175)

Avail: HC available no charge from Issuing Activity. Attn: Maj. Morton, Bldg. 450, Wright-Patterson AFB, Ohio 45433. No copies furnished by DDC or NTIS

Results of an experimental investigation are presented for the behavior of laminar boundary layers on a compression corner model simulating a lift surface followed by a control surface. The effect of model span and chord length is discussed to obtain fully developed regions of separation and consistent data. The experimental data is compared with an analytic approach for the prediction of the beginning of the separation interaction. Generally good agreement was obtained permitting further development of the effects of Mach number, Reynolds number, heat transfer, and flap deflection angle on the extent of separation. Possible extension of the analysis to turbulent boundary layers is indicated. Author

N71-19906# Norges Tekniske Hoegskole, Trondheim. Inst. for Mekanikk.

INVESTIGATION OF STREAMWISE VORTEX SYSTEMS IN CURVED FLOW Final Summary Report, 1964–1970

Leif N. Persen Wright-Patterson AFB, Ohio ARL Sep. 1970 24 p refs

(Contract F61052-69-C-0043)

(AD-716478; ARL-70-0156) Avail: NTIS CSCL 20/4

The report contains a summary of investigations on streamwise directed vortices in the period 1964-1970. Details are to be found in separate reports which are listed in the references. An attempt was made to review all the results obtained and to summarize the results in such a form that they give a complete picture of the present knowledge in the field. Author (GRA)

N71-19931*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTAL EVALUATION OF FOUR TRANSFER FUNCTIONS FOR A SINGLE TUBE BOILER WHICH ARE DYNAMICALLY INDEPENDENT OF EXIT RESTRICTIONS

Grady H. Stevens, Jack H. Goodykoontz, and Eugene A. Krejsa Washington Mar. 1971 22 p refs

(NASA-TM-X-2247; E-5949) Avail: NTIS CSCL 20D

Four transfer functions of electrical network theory were applied to boiler dynamics. These functions were calculated from impedance measurements taken for a single tube boiler with inserts. The data were taken for a single steady-state condition for which the boiler generated superheated vapor. Hot water was used to boil the working fluid, Freon-113. Dynamic data were obtained showing these functions to be independent of restrictions placed at the boiler exit. The inlet impedance and the flow to flow transfer ratio were shown to be dominated by time delay effects. The exit pressure to exit flow ratio was shown to have characteristics of mass storage. Author

N71-19952# Aix-Marseilles Univ. (France). Inst. de Mecanique des Fluides.

THEORETICAL AND EXPERIMENTAL STUDIES OF A HIGH TEMPERATURE HYPERSONIC BOUNDARY LAYER WITH AN ADVERSE PRESSURE GRADIENT [ETUDE THEORIQUE ET EXPERIMENTALE D'UNE COUCHE LIMITE HYPERSONIQUE CHAUDE EN PRESENCE D'UN GRADIENT DE PRESSION DEFAVORABLE]

R. Marmey, J. P. Guibergia, and E. Brocher Jul. 1970 69 p refs In FRENCH

(Contract DRME-516/68)

Avail: NTIS

Boundary layer interactions with nonviscous outflows of hypersonic or supersonic air inlets are reported. A computer program was used to analyze aerodynamic interaction data of conical pointed axisymmetric bodies of resolution having differing curvatures, in high- and low-enthalpy shock tunnel tests. Shock values were determined from convective heat flow distributions and pressures on the wall. Results established the formation of a weak shock wave between the conical point and the conical envelope; this shock wave was refracted and detached and produced upon collision with an obstacle a laminar boundary layer until it reattached to the envelope again. Convective heat flux distribution on the envelope was a cross function between curvature and Reynolds number. Transl. by G.G.

N71-20087# United Kingdom Atomic Energy Authority, Harwell (England).

CORRELATION OF CRITICAL HEAT FLUX FOR THE VERTICAL FLOW OF WATER IN UNIFORMLY HEATED CHANNELS

G. F. Hewitt, H. A. Kearsey, and J. G. Collier Aug. 1970 25 p refs

(AERE-R-5590) Avail: AEC Depository Libraries; HMSO 4s BIS $0.80

A correlation of critical heat flux (or burnout) data for tubes is described. This correlation is developed from the critical quality versus boiling length concept as suggested by earlier work. The performance of this correlation was systematically tested against a data bank and was compared with that of other commonly used methods. Significant improvements over these other methods are observed. A correlation of similar form which was developed for annuli is described and the application of this correlation to rod bundle data is reported. Encouraging agreement was obtained with data for a wide range of rod bundles. Author (NSA)

N71-20118# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.

SIMILARITY BETWEEN TWO PHASE LIQUID-VAPOR FLOWS WITH HEAT EXCHANGE [SIMILITUDE DES ECOULEMENTS DIPHASIQUES LIQUIDE-VAPEUR AVEC ECHANGES DE CHALEUR]

J. A. Boure 1970 10 p refs In FRENCH Presented at the 4th Intern. Heat Transfer Conf., Versailles, France, 31 Aug.–5 Sep. 1970

(CEA-CONF-1648; CONF-700805-3) Avail: AEC Depository Libraries

A method of establishing the similarity rules applicable to systems depending upon numerous parameters, such as two-phase flow, is proposed. This method was applied to liquid-vapor flows with heat exchange. For critical heating phenomena (burnout), the rules derived were compared with experimental results. A satisfactory simulation is possible. Author (NSA)

N71-20127*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

TWO-DIMENSIONAL, SUPERSONIC MIXING OF HYDROGEN AND AIR NEAR A WALL

Charlie L. Yates Washington NASA Mar. 1971 46 p refs

(Contract NASr-76)

(NASA-CR-1793) Avail: NTIS CSCL 20D

Parallel injection of hydrogen at Mach 1.19 from a rectangular wall-slot into a Mach 2.1 airstream was experimentally investigated using instream probes. The development of pressure, temperature, composition and velocity profiles was measured to a downstream distance of 30 slot heights for two values of the hydrogen-to-air

mass flux ratio: 0.088 and 0.120. From the data, there are determined the growth rates of the turbulent species, energy and momentum transfer layer thicknesses, and the decay rates of the composition, temperature and velocity maxima. The attainment of self-similarity in the case of species transfer is also examined. Author

N71-20195*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A STUDY OF THE MIXING OF HYDROGEN INJECTED NORMAL TO A SUPERSONIC AIRSTREAM

R. Clayton Rogers Washington Mar. 1971 54 p refs
(NASA-TN-D-6114; L-7386) Avail: NTIS CSCL 20D

The effects of the ratio of jet dynamic pressure to free-stream dynamic pressure, in the range of 0.5 to 1.5, on the penetration and mixing of a sonic hydrogen jet injected normal to a Mach 4 airstream were determined. Free-stream conditions consisted of a stagnation temperature of 300 K and stagnation pressures of 13.6 and 20.4 atmospheres. Turbulent boundary-layer thickness at the injection station was 2.70 injector diameters. Measurements of hydrogen volume fraction and pitot pressure were made at downstream stations between 7 and 200 injector diameters. It was found that the penetration trajectory was proportional to the 0.3 power of the dynamic-pressure ratio and the decay of the maximum concentration (to values of 0.1) was inversely proportional to the square root of the downstream distance. Nondimensional concentration profiles for the vertical surveys were approximated by Gaussian-type functions and showed similarity at stations equal to or greater than 60 injector diameters. Author

N71-20196# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.

CIRCULATION CONTROL BY SLOT SUCTION ON A CIRCULAR CYLINDER. MEASURED FORCE CHARACTERISTICS OF A SMOOTH DOUBLE SLOTTED CYLINDER

R. A. Tyler and R. G. Williamson Jul. 1970 30 p refs
(NRC-11714; LR-539) Avail: NTIS

Force characteristics are presented for a uniformly smooth circular cylinder, equipped with one and two spanwise sharp-edged slots (slot separation 60 deg, s/d = 0.05). Suction coefficients from zero to about 1.0 (per slot) were applied over the complete incidence range at low mainstream Mach number (Mn < 0.15, R sub e = 100,000 to 700,000). The single slot data are compared with earlier results for a relatively rough cylinder. The two-slot data are examined in some detail for the zero suction rate over the complete incidence range, and the full test range of suction coefficient at the particular incidence involving rear symmetry of slot position. Author

N71-20262# Louisiana State Univ., Baton Rouge.

INVESTIGATION OF THE CHARACTERISTICS OF FLUIDS VENTED INTO A VACUUM

Riddle Steddum, Dupree Maples, and Frank M. Donovan *In* NBS Space Simulation Oct. 1970 p 905–914 refs (See N71-20201 09-11)
Avail: SOD $5.25

In order to study the dynamics of fluid jets in a space environment, a high vacuum system was modified to allow the injection of fluids into a vacuum region while maintaining a pressure below 0.1 N/sq m. The cone angles, individual particle velocities, and mass flow rates of water sprays under vacuum conditions were measured. Individual particle velocities of sprays produced by outgassed water were lower than particle velocities of sprays produced by water with a definite amount of dissolved gas. Author

N71-20256*# Scripta Technica, Inc., Washington, D.C.

SECOND APPROXIMATION IN THE PROBLEM OF STRONG VISCOUS INTERACTION ON THIN THREE DIMENSIONAL BODIES [VTOROE PRIBIZHENIE V ZADACHE O SILNOM VIAZKOM VZAIMODEISTVII NA TONKIKH PROSTRANSTVENNYKH TELAKH]

V. V. Mikhailov NASA Mar. 1971 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidk. Gaza (Moscow), Sep.–Oct. 1970 p 107–113
(Contract NASw-2036)
(NASA-TT-F-13538) Avail: NTIS CSCL 20D

A hypersonic perfect gas flow past a thin three dimensional body under conditions of strong viscous interaction is studied. Relations are derived which make it possible to reduce the problem of determining the aerodynamic characteristics of an axisymmetric body to a calculation of a flow past a certain equivalent body of revolution at zero angle of attack. A second approximation for the heat transfer and drag coefficients is obtained by the method of outer and inner coalescing asymptotic expansions. An estimate is made of the range of applicability and the accuracy of the asymptotic theory on the basis of a comparison with examples of exact numerical calculations. Author

N71-20257*# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.

A REVIEW OF FUNDAMENTAL EQUATIONS OF THE MIXTURE OF A GAS WITH SMALL SOLID PARTICLES

S. I. Pai Aug. 1970 60 p refs
(Grant NGR-21-002-256)
(NASA-CR-117309; BN-668) Avail: NTIS CSCL 20D

The flow of a mixture of a gas and small solid particles and the solid particle behavior in the mixture are considered. The fundamental equations of the mixture of the gas and the pseudo-fluid of solid particles are derived from both the continuum theory point of view and the simple kinetic theory point of view. Relations between these two points of view are given and discussed by comparing the corresponding terms. Finally discussed are two simplified cases of the fundamental equations which consist of: (1) the thermodynamics of the mixture of solid particles and a gas; and (2) the case of negligibly small volume fraction of solid particles. Author

N71-20261# National Aeronautical Establishment, Ottawa (Ontario).

THE INCOMPRESSIBLE LAMINAR BOUNDARY LAYER OVER A SLENDER BODY OF REVOLUTION AT SMALL INCIDENCE

T. R. F. Nonweiler Apr. 1970 41 p ref
(NRC-11665; LR-532) Avail: NTIS

The linearized perturbation equations for the incompressible flow within the boundary layer of a body of revolution at incidence are solved by using slender body theory to describe the inviscid flow field. The calculations were made by digital computer, using adaptive procedures to keep close control of truncation errors. Author

N71-20288*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN AND PERFORMANCE OF A 0.9 HUB-TIP-RATIO AXIAL FLOW PUMP ROTOR WITH A BLADE-TIP DIFFUSION FACTOR OF 0.63

Donald C. Urasek Washington Mar. 1971 34 p refs
(NASA-TM-X-2235; E-5765) Avail: NTIS CSCL 20D

A 9-inch diameter axial flow rotor with a 0.9 hub-tip radius ratio, a design flow coefficient of 0.70, and a blade tip diffusion factor of 0.63 was tested in cold water under both cavitating and noncavitating conditions. Radial surveys of the flow conditions at the blade inlet and outlet were made. At design flow, the rotor produced an overall head-rise coefficient of 0.537 with an overall efficiency of 92.0 percent. The efficiency remained high over the entire flow range. Author

N71-20343*# Techtran Corp., Glen Burnie, Md.
FLOW OF A VISCOUS RADIATING GAS AROUND BLUNT BODIES [OBTEKANIYE ZATUPLENNYKH TEL VYAZKIM IZLUCHANUSHCHIM GAZOM]
I. M. Breyev et al Washington NASA Mar. 1971 14 p refs Transl. into ENGLISH from Zh. Vychislitelnoi Mat. i Mat. Fiz. (Moscow), v. 10, no. 5, Sep.–Oct. 1970 p 1228–1237
(Contract NASw-2037)
(NASA-TT-F-13531) Avail: NTIS CSCL 20D

The flow between a shock wave and the front surface of a body is studied using simplified Navier-Stokes equations containing the terms from the gas dynamic equations for nonviscous flow and the boundary layer equations. Two models are used to approximate the spectral dependence of the coefficient of absorption of air, one allowing consideration of radiation only in a continuous spectrum, the other allowing consideration of radiation both in the continuous spectrum and in spectral lines. The initial system of equations is solved by the method of finite differences. Author

N71-20417*# Aerojet Liquid Rocket Co., Sacramento, Calif.
ANALYSIS OF THE LOW FREQUENCY STABILITY OF A GAS-TAPOFF CYCLE USING GASEOUS HYDROGEN AND GASEOUS OXYGEN, APPENDIX A
In its Stability Characterization of Advanced Injectors, Design Guide, Vol. 2 Feb. 1971 51 p (See N71-20415 09-28)
Avail: NTIS HC $6.00/MF $0.95 CSCL 20D

The feed system coupled one-dimensional stability problem for a gas tapoff cycle using gaseous hydrogen and oxygen is analyzed. The tapoff cycle considers that a portion of the combustion product gases are tapped off for use elsewhere. This program includes the wave motion and heat motion (entropy wave) in the chamber. The burning process is treated as a process of temperature, molecular weight and specific heat change. A very general expression relating injection rate to burning rate is used. The many equations obtained are solved using matrices. The matrix operations however are used only on the equations involving real variables. The complex arithmetic used on the complex equations has been built into the program so the program can be used on a variety of computers. The final result of the analysis is a system characteristic equation. Stability of the system can be determined using the Nyquist criteria. Author

N71-20436* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FLOW FIELD SIMULATION Patent
Robert A. Jones, inventor (to NASA) Issued 19 Aug. 1969 (Filed 28 Dec. 1967) 6 p Cl. 73-147; Int. Cl. G01m9/00
(NASA-Case-LAR-11138; US-Patent-3,461,721; US-Patent-Appl-SN-694317) Avail: US Patent Office CSCL 20D

A method for simulating the flow fields that would be encountered by a blunt vehicle upon entry into a planetary atmosphere is described without involving the high temperatures that would occur in actual flight. The test gas used in the wind tunnel is a heavy gas having a small specific heat ratio, such as CF4. Schematics of the wind tunnel, a blunt vehicle model body under test conditions, and a simulated test for shock density ratio determination by measurement of shock standoff distance of a sphere are presented as well as a plot of the shock density ratios as a function of Mach number for a specific total pressure. J.M.

N71-20478# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Hydraulics and Water Resources.
WAVE UPLIFT PRESSURES ON HORIZONTAL PLATFORMS
Jonathan A. French Jun. 1969 436 p refs Sponsored in part by Sloan Fund for Basic Research
(Grant NSF GK-1729)
(KH-R-19) Avail: Issuing Activity

The rapidly-varying peak uplift pressure and the slowly-varying positive and negative uplift pressures that are known to be exerted by waves against the underside of a horizontal peir or platform located above the still water level, but not higher than the crests of the incident waves were investigated. In a two-dimensional laboratory study conducted in a 100-ft long by 15-in.-wide by 2-ft-deep wave tank with a horizontal smooth bottom, individually generated solitary waves struck a rigid, fixed, horizontal platform extending the width of the tank. Pressure transducers were mounted flush with the smooth soffit, or underside, of the platform. The hydrodynamics of the flow beneath the platform are described qualitatively by a simple analysis, which relates peak pressure and positive slowly-varying pressure to the celerity of the wave front propagating beneath the platform, and relates negative slowly-varying pressure to the process by which fluid recedes from the platform after the wave has passed. Author

N71-20597# Idaho Nuclear Corp., Idaho Falls.
PARTICLE SIZE CONTROL BY JET GRINDING IN A FLUIDIZED BED DENITRATOR
G. W. Hogg Nov. 1970 26 p refs
(Contract AT(10-1)-1230)
(IN-1439) Avail: NTIS

The application of jet grinders to the control of particle size in a fluidized-bed denitrator was evaluated. Correlations showing the effect of jet velocity, particle size, attrition index, jet location and orientation, and impact plates in reducing mean particle size were developed from experimental data. A jet grinder was used to control particle size in a pilot-plant denitrator. Author (NSA)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N71-19406 New Zealand. Dept. of Scientific and Industrial Research, Wellington. Geophysics Div.
TOPOGRAPHIC-ISOSTATIC GRAVITY CORRECTIONS FOR NEW ZEALAND
W. I. Reilly 1970 37 p refs *Its* Geophys. Mem. No. 7
(Bull-203) Copyright. Avail: Issuing Activity

Topographic-isostatic corrections, including the indirect effect, have been calculated at 8 points per degree square over the New Zealand region, following the Airy-Heiskanen system with normal thickness of crust T=30 km. The results are given in the form of numerical values on a map at 1:2,000,000 and as contours of equal correction on a map at 1:4,000,000. For each computing point is shown (1) the topographic correction from 21.9 km out to the limit of Hayford's zone O (166.7 km), (2) the isostatic correction for Hayford's zones A to 1 (0 deg to 180 deg) combined with the topographic correction from 21.9 km to 180 deg, and (3) the height of the calculation point, derived from the mean height of the surrounding terrain. The method of calculation follows Heiskanen's mass-line method, using for Hayford's zones A'O the mean heights of 7.5 × 7.5 minute squares, and for zones 18-11 the mean heights of 30 × 30 minute squares. The corrections for zones 10-1 have been interpolated from the charts published by the Isostatic Institute of Helsinki. The topographic-isostatic corrections are being used for the calculation of isostatic anomalies, and in the production of gravity anomaly maps of New Zaland at scales of 1:250,000, 1:1,000,000, and 1:4,000,000. Author

N71-19409# Coast Guard, Washington, D.C. Oceanographic Unit.
OCEANOGRAPHY OF THE WEDDELL SEA.

JANUARY–MARCH 1968
Robert B. Elder and James M. Seabrooke Apr. 1970 105 p refs
(PB-195893; USCG-373-30; Rept-30) Avail: NTIS CSCL 08J

During January-March 1968, the USCGC Glacier(WAGB4) penetrated the pack ice of the Weddell Sea to over 75 degrees S. latitude in support of the first phase of the International Weddell Sea Oceanographic Expedition. Fifty-eight oceanographic stations were occupied in the southwestern and western Weddell Sea, most of which were in areas never before surveyed. The U.S. Coast Guard oceanographic unit performed analyses of temperature, salinity, oxygen and dissolved nutrients. These data are presented, accompanied by a preliminary interpretation of the oceanography of the Weddell Sea. The water masses and processes involved in the formation of Antarctic bottom water are discussed. Author (GRA)

N71-19410# Rhode Island Univ., Kingston.
CRITERIA FOR RECOGNITION OF ESTUARINE WATER POLLUTION BY AERIAL REMOTE SENSING Technical Report, 1 Jul. 1969 –30 Jun. 1970
John J. Fisher 30 Jun. 1970 15 p refs
(Contract DI-14-31-0001-3040)
(PB-195976; W71-01900) Avail: NTIS CSCL 13B

Multispectral aerial photographic remote sensing analysis was made of water quality in estuarine areas. Photographic interpretation was compared with ground-truth data. Four film emulsions proved most efficient; panchromatic, black and white infrared, color, and color infrared. A simple inexpensive four camera system using these films was designed and developed. Author (GRA)

N71-19444# Teledyne Isotopes, Westwood, N.J.
ATMOSPHERIC PROPAGATION STUDIES UP TO 30 SEPTEMBER 1969
Hernan A. Montes, Chester E. Grosch, Melvin J. Hinica, and Eric S. Posmentier Jul. 1970 175 p refs
(Contract F44620-69-C-0038; ARPA Order 1316)
(AD-716541; IWL-7556-175; AFOSR-70-2734TR) Avail: NTIS CSCL 4/1

A summary is given of significant results obtained during the research effort corresponding to the period 1 September 1968 - 30 September 1969. Particular emphasis was given to the construction of a phase-path doppler sounder array. Signals detected by the microbarograph array on the occasion of the Chinese nuclear test of 29 September 1969 are compared with signals from previous tests. There appears to be a seasonal effect on the propagation and/or bandwidth of these signals. Preliminary work on ionospheric motion background using phase-path sounder data indicates that the background activity can be broadly separated into two period ranges: periods longer and shorter than 5 minutes. The shorter periods appear to have a hydromagnetic origin while the longer periods are probably due to internal gravity wave activity. A theoretical investigation of the interaction between instability waves and internal gravity waves in the atmosphere showed that internal gravity waves are trapped within a layer where the shear flow velocity is greater than the speed of sound and that the phase velocity of the internal gravity waves is approximately equal to the maximum velocity of the shear flow. Author (GRA)

N71-19447# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
AN ANALYSIS OF THE WAVE INTERACTION DISTURBING ANTENNA SYSTEM
M. J. Fithian 31 Jan. 1971 113 p refs
(Grant NSF GA-1456)
(SR-367) Avail: Issuing Activity

The system is a linear, broadside array of 1.3 wavelength elements with .5 wavelength parasitic directors. It is designed to operate at a frequency of 4.5 MHz. The theoretical radiation patterns of the array are derived and plotted for the designed frequency and the second and third harmonics. Using a scale model, the radiation patterns are obtained experimentally for the three frequencies. Various modifications are made on the model which simulate the same changes on the full-scale system. These changes were made to test whether the existing system could be improved. At the harmonics, it was found that the side lobes increase and that most of the energy is radiated off the vertical. A marked improvement in the beamwidth and side-lobe level of the system at the fundamental occurred if reflectors were used with the driven elements. Author

N71-19448 Arizona Univ., Tucson. Inst. of Atmospheric Physics.
TABLES OF THE RADAR CROSS SECTIONS OF DRY AND WET ICE SPHERES
Louis J. Battan, Samuel R. Browning, and Benjamin M. Herman 1 Jun. 1970 24 p refs
(Grant NSF GA-13949)
(TR-21) Avail: Issuing Activity

Microwave radar scattering cross sections were calculated from the Mie scattering equations for wavelengths from 1.87 to 10.0 cm. The calculations include the attenuation, scattering, absorption, and backscattering cross sections. N.E.N.

N71-19465*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
A STUDY OF THE THERMAL STRUCTURE OF THE MESOSPHERE AND LOWER THERMOSPHERE. AERONOMY PROGRAM REPORT NO.5
John Joseph Olivero, Jr. (Ph.D. Thesis) Sep. 1970 241 p refs
(Grants NGR-23-005-360; NSF GA-1025; ORA Proj. 03015; ORA Proj. 03339)
(NASA-CR-117047; Rept.-03339-1-T) Avail: NTIS CSCL 04A

Mechanisms which maintain the energy balance from 50 to 120 km are considered. The physical processes investigated are absorption of solar radiation below 3000 A; IR radiative transfer of CO2, O3, and O; chemical recombination of O and O.3; dissipation of atmospheric tidal oscillations and gravity waves; and molecular and eddy thermal transport. The role of vertical eddy transport in the overall energy budget is emphasized. A global scale model is derived as a geographical and seasonal average of the thermal structure and processes. Below the mesopause the ozone concentration has a major effect on thermal transport. Above the mesopause the chief uncertainty is the upward flux of tidal energy, assumed to be dissipated above 120 km, redistributed latitudinally, and to appear as a hemisphere average downward heat flux at 120 km. The resulting eddy transport is too large, leading to the conclusion that the bulk of the tidal energy flux must be either reflected or dissipated at heights below 100 km. Thermal models are also presented for individual latitude cases for solstice and equinox conditions. The effects of meridional circulation are apparent, especially at high latitudes. Author

N71-19501# National Center for Atmospheric Research, Boulder, Colo.
MODERN DEVELOPMENTS IN THE THEORY OF THE GENERAL OCEAN CIRCULATION: A SYMPOSIUM
Elliott Schulman, ed. Oct. 1970 72 p refs Symp. held at Boulder, Colo., 1969 Sponsored by NSF
(NCAR-TN-51) Avail: Issuing Activity

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N71-19502# Miami Univ., Coral Gables, Fla. Inst. of Atmospheric Science.

LINEAR THEORY OF THE RESPONSE OF A TWO-LAYER OCEAN TO A MOVING HURRICANE

James E. Geisler *In* Natl. Center for Atmospheric Res. Mod. Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 1–7 (See N71-19501 09-13)

Avail: Issuing Activity

The linear response is considered of an inviscid two-layer model of a deep ocean on an f-plane to a hurricane translating across the surface at a constant speed. The wind-stress forcing is a localized, radially symmetric pattern of positive wind-stress curl and negative pressure anomaly. Of particular note is the so-called pycnocline follower used to obtain a time series of the vertical excursion of the isopycnics. The basic assumptions for the model are linearity (i.e., the motion of the interface is small compared to the undisturbed depth), f-plane analysis, and steady state. The latter refers to a coordinate system located relative to the storm itself. Author

N71-19503# Environmental Science Services Administration, Princeton, N.J. Geophysical Fluid Dynamics Lab.

THE ANTARCTIC CIRCUMPOLAR CURRENT

Adrian E. Gill *In* Natl. Center for Atmospheric Res. Mod. Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 9–11 (See N71-19501 09-13)

Avail: Issuing Activity

Numerical calculations of the three-dimensional baroclinic flow were made to see if these features could be ascribed solely to the existence of a clear passage around the pole, a circumstance unique to the southern ocean. The numerical model used is similar to one used in studies of the three-dimensional ocean circulation. The geometry of the basin was simplified by eliminating all bottom topographic effects. This neglects the possibly important influences of the shallowing of the ocean in the Drake Passage between South America and Antarctica, the continental slopes, and the Scotia Ridge which lies due east of the passage. The northern boundary was established at the equator where a symmetry condition on temperature and velocity is imposed. Because of the great distance involved, it was assumed that the conditions at the equator would have little effect on the ocean's behavior in the polar region. Author

N71-19504# Oregon State Univ., Corvallis.

THE FREE OSCILLATIONS OF FLUID ON A HEMISPHERE BOUNDED BY MERIDIANS OF LONGITUDE

M. S. Longuet-Higgins *In* Natl. Center for Atmospheric Res. Mod. Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 13–16 ref (See N71-19501 09-13)

Avail: Issuing Activity

The problem was to determine, by precise calculation, the possible modes of fluid oscillation in an ocean basin comparable in size to the Pacific or Atlantic. Author

N71-19505# Oregon State Univ., Corvallis.

THE LONGSHORE CURRENTS GENERATED BY OBLIQUELY INCIDENT SEA WAVES

M. S. Longuet-Higgins *In* Natl. Center for Atmospheric Res. Mod. Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 17–20 (See N71-19501 09-13)

Avail: Issuing Activity

The effect of waves striking a straight coastline at an angle is considered. The theory incorporates three features: radiation stress of the waves, a reasonable estimate of bottom friction, and horizontal mixing. Author

N71-19506# Texas A&M Univ., College Station.

SOME THEORETICAL PROBLEMS IN OCEANOGRAPHY

Robert O. Reid *In* Natl. Center for Atmospheric Res. Mod. Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 21–24 (See N71-19501 09-13)

Avail: Issuing Activity

The purpose is not to present solutions to specific theoretical problems but rather to look at the existing solution of some problems in perspective, in hopes of giving insight into the interaction among them. A simplified listing of the theoretical problems includes: the equilibrium thermodynamics of seawater and its physical properties, the small-scale transfer processes in the air-sea interaction, the quasi-steady circulations, the transient motions, and the laboratory models and the design of experiments at sea. Author

N71-19507# Texas A&M Univ., College Station.

TRANSIENT OCEAN CIRCULATIONS

Robert O. Reid *In* Natl. Center for Atmospheric Res. Mod. Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 25–29 (See N71-19501 09-13)

Avail: Issuing Activity

Two transient motion circulation models for the Gulf of Mexico are discussed. The first model involves a barotropic flow in a partially enclosed basin with variable topography. The flow is driven by a flux of vorticity and mass at a southern port (the Yucatan Straits) with equal flux at a southeastern port (the Straits of Florida). Numerical integration was achieved by keeping the Jacobian time centered, with centered time stepping. The second model is for a symmetric atmospheric wind vortex sitting over a boundless, stratified ocean. Results are summarized for the numerical integration of this problem which was carried out with 60 vertical and 90 horizontal points. E.C.

N71-19508# Johns Hopkins Univ., Baltimore, Md.

AGGRESSIVE ASPECTS OF TURBULENCE

Owen M. Phillips *In* Natl. Center for Atmospheric Res. Mod.

Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 31–35 (See N71-19501 09-13)
Avail: Issuing Activity

The aggressive nature of turbulence is analyzed, i.e., the tendency for a patch of turbulence to encroach upon and engulf surrounding fluid, and to the indiscriminate nature of turbulent eddy interactions. Examples of encroachment tendency are the growth of a turbulent mixed layer of water under a turbulent wind, the growth of turbulent plumes of heated air, the breakdown of steep density gradients via Kelvin-Helmholtz instability, and the growth of turbulent jets through entrainment. Entrainment is evaluated in the following sense: an interface described by $z - Xi(x,y,t) = 0$ separates turbulent and irrotational fluid. Author

N71-19509# California Univ., Livermore. Lawrence Radiation Lab.
NUMERICAL MODELS OF OCEAN CIRCULATION
W. Patrick Crowley *In* Natl. Center for Atmospheric Res. Mod. Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 37–39 (See N71-19501 09-13)
Avail: Issuing Activity

Work is discussed that has been done on three numerical ocean models: a six-layer baroclinic circulation model with a free upper surface, a one-layer homogeneous model with a free upper surface, and a one-layer homogeneous model with a fixed upper surface. These three models are tied together by the filtering problem, and the purpose is to discuss the effect of filtering. Author

N71-19510# Environmental Science Services Administration, Princeton, N.J. Geophysical Fluid Dynamics Lab.
CLIMATE CALCULATION WITH A COMBINED OCEAN ATMOSPHERE MODEL
Kirk Bryan *In* Natl. Center for Atmospheric Res. Mod. Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 41–43 (See N71-19501 09-13)
Avail: Issuing Activity

The purpose is to report on a calculation based on a combined numerical model of the atmosphere and ocean. The model has successfully produced many features of climate starting from arbitrary initial conditions. Author

N71-19511# Environmental Science Services Administration, Princeton, N.J. Geophysical Fluid Dynamics Lab.
SOME NUMERICAL OCEANOGRAPHIC EXPERIMENTS
Kirk Bryan *In* Natl. Center for Atmospheric Res. Mod. Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 45–46 (See N71-19501 09-13)
Avail: Issuing Activity

Three numerical experiments modeling baroclinic flow of oceanographic interest are summarized; in all cases, a Boussinesq, hydrostatic, rotating fluid is driven by differential heating at the surface, with the colder region to the north. Constant coefficients of eddy viscosity and eddy diffusivity are used to model diffusive effects. Author

N71-19512# California Univ., La Jolla. Inst. of Geophysics and Planetary Physics.
ABYSSAL TIDES
Walter H. Munk *In* Natl. Center for Atmospheric Res. Mod. Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 47–50 (See N71-19501 09-13)
Avail: Issuing Activity

Three developments facilitating tidal studies are cited: the availability of large, fast computers, time series analyses, and the capability of measuring deep water tides avoiding local effects in shallow regions. Analytical work on Pacific Ocean deep tide data is mentioned. The tidal distortion effect of the solid earth on the ocean tide is discussed as well as the solid earth response to the tide-producing forces. E.C.

N71-19513# Harvard Univ., Cambridge, Mass.
GULF STREAM MEANDERS
Allan R. Robinson *In* Natl. Center for Atmospheric Res. Mod. Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 51–55 (See N71-19501 09-13)
Avail: Issuing Activity

Physical problems related to the coherent meander pattern of the Gulf Stream from Cape Hatteras to the Grand Banks are reviewed. Temperature towing and aerial infrared measurement techniques for mapping the Stream are cited. The quasi-steady theory of the meandering Stream is summarized and simple models of the time dependent structure of the Stream are considered. E.C.

N71-19514# Harvard Univ., Cambridge, Mass.
ON OCEAN CIRCULATION MODELING
Allan R. Robinson *In* Natl. Center for Atmospheric Res. Mod. Develop. in the Theory of the Gen. Circulation: A Symp. Oct. 1970 p 57–61 (See N71-19501 09-13)
Avail: Issuing Activity

Problems in understanding the general circulation of the oceans are discussed. Limitations of simple, analytical models are examined, and difficulties in modeling the world ocean circulation are reviewed. E.C.

N71-19531# Battelle Memorial Inst., Columbus, Ohio.
PROPOSAL FOR AN INTERNATIONAL AIR POLLUTION INFORMATION ANALYSIS CENTER
John W. Murdock *In* AGARD Inform. Analysis Centres Feb. 1971 5 p (See N71-19526 09-07)
Avail: NTIS

The establishment within NATO of an international information analysis center on air pollution is proposed. The application of information analysis concepts to this critical field, which increasingly involves multidisciplinary research and development efforts in all the industrialized societies of the world, would create a comprehensive base of knowledge that would be utilized by (1) research scientists of many nations to assure maximum effective contributions to solving air pollution problems and (2) by administrators and policy makers to make the major decisions that determine what research is to be done and how it is to be funded. Methods of establishing the information analysis center, its organization, and the functions of its international staff are described. Author

N71-19532# Admiralty Oil Lab., Cobham (England).
MARITIME POLLUTION
R. P. Langston *In* AGARD Inform. Analysis Centres Feb. 1971 7 p refs (See N71-19526 09-07)
Avail: NTIS

A discussion is presented on the feasibility of an international maritime pollution information analysis center. Emphasis is placed on the growing recognition of the need for a better understanding of what takes place when oil products are spilled at sea. The proposed center would process, on an international basis, all data dealing with the nature of oil spills, the consequences, and the technologies employed in the cleaning up process. In addition, incidences of oil spillage would be reported to the center and this information would be routinely processed and disseminated to all member countries. Other benefits that could be derived from the proposed center are briefly discussed and include: (1) the acquisition of data on weather conditions and water movements, (2) the availability of industrial and ecological information, (3) the identification of pollutants, and (4) the formulation of legal aspects and medical/toxic aspects. D.L.G.

N71-19551# Physics International Co., San Leandro, Calif.
EXPERIMENTAL STUDIES OF STRESS-WAVE PROPAGATION IN EARTH MEDIA

M. W. McKay, R. R. Shadel, R. P. Swift, and C. Young Sep. 1970 56 p refs
(Contract DASA01-69-C-0071)
(AD-714012; PITR-146-3; DASA-2525) Avail: NTIS CSCL 8/11

The response of several geologic materials to explosively induced spherical shock waves has been studied. Measurements made include stress, particle velocity, and strain gauge time histories at stress levels from 10 to 150 kbars. The influence of water content and cracks was also studied. Gasgun impact experiments employing oblique target and impactor design have demonstrated the feasibility of studying the propagation of shear waves in plane geometry. Author (GRA)

N71-19554# Boston Univ., Mass. Dept. of Astronomy.
THEORETICAL STUDIES OF SOLAR GEOPHYSICAL RELATIONSHIPS USING RADIO TELESCOPE AND SATELLITE DATA Final Report, 1 Nov. 1967 – 31 Aug. 1970
Michael D. Papagiannis Nov. 1970 35 p refs
(Contract F19628-68-C-0097)
(AD-715938; AFCRL-70-0606) Avail: NTIS CSCL 4/1

The research conducted under the contract includes the following projects: A study of the ionospheric total electron content during magnetic storms; A study of the world-wide distribution of the evening anomaly of the ionosphere; A study of the intensity and fluctuations of the 6300 A airglow line during periods of high and low scintillation activity; A study of the spectral characteristics of solar radio bursts in the microwave region (600-35,000 MHz); and, a model for the source of Class I (non-impulsive) solar x-ray bursts. Author (GRA)

N71-19575# Air Force Cambridge Research Labs., Bedford, Mass.
PROCEEDINGS OF MEETING ON OPERATION PCA 69
James C. Ulwick and Charles A. Blank (DASA, Washington, D.C.), comps. 28 Oct. 1970 211 p refs Conf. held at Chestnut, Mass., 31 Mar. – 1 Apr. 1970 Supported in part by DASA *Its* Spec. Reports No. 110
(AD-716385; AFCRL-70-0625) Avail: NTIS CSCL 4/1

Operation PCA 69 was a coordinated rocket, satellite, aircraft and ground measurement program designed to study the physical chemistry of the ionospheric D-region in conjunction with and by means of a solar proton event. During the event of 2 November 1969 a total of 36 rockets were launched at Churchill, Canada over a two-day period in coordinated series for the measurement of various atmospheric parameters with emphasis on the night-day variations, but including measurements during the transition periods of sunrise and sunset. In addition, 11 rockets were launched to provide certification and background information. Electron and proton flux measurements were made on several satellites. Ground measurements including 30 MHz riometers, magnetometer, ionosonde, and partial reflection experiments were made at Churchill during the period, and aircraft optical measurements were made on 2 November 1969. A conference was held at Boston College, Massachusetts on 31 March and 1 April 1970 to assess the quantity and quality of the data. Preliminary results are presented either as papers or summaries. Author (GRA)

N71-19602# Geological Survey, Washington, D.C.
REMOTE SENSING BIBLIOGRAPHY FOR EARTH RESOURCES, 1968
Rita K. Llaverias and Dorothy G. Lowe Oct. 1970 260 p refs *Its* Interagency Rept. No. 203
(PB-195748; USGS-DO-70-010) Avail: NTIS CSCL 08F

Citations of literature are presented for the following: agriculture, atmospheric sciences, cartography, fisheries, forestry, geodesy, geography, geology, geophysics, hydrology, land evaluation, limnology, marine resources, meteorology, oceanography, range resources, sensors, techniques, and urban development. A personal author index and a corporate author index are provided for most of the 801 citations. The subject index contains two or more descriptors for each item. Author (GRA)

N71-19603# Pennsylvania State Univ., University Park.
TURBULENCE CHARACTERISTICS OVER HETEROGENEOUS TERRAIN Final Report
Hans A. Panofsky, Carl A. Mazzola, James Woods, and Karl Eidsvik Sep. 1970 89 p refs
(Contract DAEA18-69-C-0079)
(AD-716361; ECOM-0079-F) Avail: NTIS CSCL 4/1

The report summarizes some results from three separate field studies, in the United States and Norway. These conclusions are reached: The Bradshaw-Peterson hypothesis that the ratio of the standard deviation of velocity components to the friction velocity is a universal function of Richardson number even when the air is not in equilibrium appears to be correct in the case of the standard deviation of vertical velocity. In that case, the ratio is approximately 1.3 in neutral air. For the horizontal velocity components, the hypothesis is only approximately true; these components have low-frequency, mesoscale contributions which obey neither Monin-Obukhov similarity nor the above-named hypothesis. The hypothesis that the ratio between dissipation and friction velocity cube over height also has a general value in neutral air appears to be correct. The value is about the reciprocal of von Karmans constant. Spectra of vertical motion, multiplied by wave number and normalized by the variance or the square of friction velocity, have universal shapes, depending only on Richardson number in stable air. Author (GRA)

N71-19606# Spectran, Inc., Downey, Calif. Microwave Sensor Systems Div.
OIL POLLUTION DETECTION AND DISCRIMINATION BY REMOTE SENSING TECHNIQUES Final Report
Jerry C. Aukland and Dennis T. Trexler 15 Oct. 1970 178 p refs
(Contract DOT-CG-03523)
(AD-716349; Rept-1001-F; USCG-714104/a/006-1) Avail: NTIS CSCL 13/2

Airborne remote sensing techniques were applied to the detection and discrimination of pollution by oil on the ocean surface. The tests were performed in the Gulf of Mexico during April, 1970. Pollutants investigated included No. 2 fuel oil, No. 6 fuel oil, 9250 lube oil, light crude oil, heavy crude oil, gasoline, and mixtures of gasoline and oil. A total of 103 oil slicks were produced as a function of spill rate and ship speed. Ship speeds were nominally 10, 14, and 17 knots and spill rates ranged from 0.02 to greater than 4.0 GPM (Gallons per Minute). Sensors used during the airborne tests included; two dual polarized microwave radiometers operating at 10.2 and 30 GHz, an infrared scanner operated in both the 4-5.5 microns and 8-14 microns regions, a dual 70 mm camera sensing visible color and infrared color, a 4-lens camera employing filters from the mid-visible to ultraviolet wavelengths. Oil was detected on the sea surface at spill rates as low as 0.2 GPM for long wavelengths sensors and at the lowest spill rates for photographic imagery using an ultraviolet filter. Anomalously warm infrared radiometric temperatures were recorded in the 4-5.5 micron region for heavy crude oil while No. 6 fuel oil appeared radiometrically cooler. Author (GRA)

N71-19628# Michigan Univ., Ann Arbor. Seismological Observatory.
CORRELATION OF INFRASONIC MICROBAROMETRIC DISTURBANCES AND LONG PERIOD SEISMIC PHENOMENA Annual Report, 1 Feb. 1969 – 31 Jan. 1970
Paul W. Pomeroy Jun. 1970 38 p refs
(Contract F44620-69-C-0085; ARPA Order 1363)
(AD-716533; Rept-02637-1-P; AFOSR-70-2732-TR, AR-1) Avail: NTIS CSCL 8/11

The report calls for detailed analyses of the correlation between infrasonic microbarometric phenomena and signals observed on long period seismographs. Specifically, these studies include acoustic wave generation (a) in the vicinity of the earthquake epicenter (b)

in the vicinity of the seismic and acoustic receivers and (c) due to coupling between Rayleigh waves and acoustic waves. The contract also provides for the study of the source and propagation characteristics of infrasonic phenomena other than those directly correlatable with seismic events. During this period, work has been concentrated on the correlation of microbarometric fluctuation and long period seismic noise. Studies of data from La Paz, Bolivia, LASA/LAMA Montana and Sugar Island, Michigan show a strong correlation between the microbarometric background noise and the long period seismic noise. It is concluded that the energy transfer is the result of deformation of the earths surface by a pressure cell loading effect. Author (GRA)

N71-19669# Princeton Univ., N.J. Dept. of Geological and Geophysical Sciences.

RESEARCH IN SEISMOLOGY Final Report, 1 Jul. 1963–31 Dec. 1969

Robert A. Phinney and Donald V. Helmberger 15 Sep. 1970 21 p refs

(Contract AF 49(638)-1243; ARPA Order 292)

(AD-716619; AFOSR-70-2716TR) Avail: NTIS CSCL 8/11

The final report describes research completed during the period 1 July 1963 to 31 December 1969. The primary objectives of the project were as follows: The development of theoretical methods for treating the amplitude and phase characteristics of body waves in the earth. The development of parallel numerical methods for computing the amplitudes and phases of body waves in a radially heterogeneous earth. The application of these results to a more complete understanding of observed long and short period signals from explosions and earthquakes. Author (GRA)

N71-19683# Florida State Univ., Tallahassee. Geophysical Fluid Dynamics Inst.

A STUDY OF EXTREMELY LOW FREQUENCY WAVES AND PROPAGATING IONOSPHERIC DISTURBANCES IN DETECTING ATMOSPHERIC NUCLEAR EXPLOSIONS Technical Report, 1 Dec. 1969–30 Nov. 1970

I. Tolstoy 30 Nov. 1970 33 p refs

(Contract F44620-69-C-0043; ARPA Order 1320)

(AD-716601; AFOSR-70-2838TR) Avail: NTIS CSCL 18/3

The report establishes a suitable Greens function model to explain the generation of long period, large amplitude gravity modes by thermonuclear and nuclear tests in the atmosphere. Thus, it is shown in a paper in press by Tolstoy and Lau, that the important mechanism here must be the rising shere of hot gas. It is not difficult to demonstrate that - for large yields, at least - this mechanism should be orders of magnitude more efficient in generating long period internal gravity wave modes efficient in generating long period internal gravity wave modes than the explosion phase proper. It is the belief now that this is the source of observed long wavelength gravity waves; although we have, in the attached report, merely illustrated the principle of the mechanism, without extending the results to a realistic model of the atmosphere, there appears to be little doubt that one may in this manner account for the large amplitudes of vertical motion observed for such disturbances traveling in the ionosphere. Author (GRA)

N71-19692# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFORMATION RETRIEVAL SYSTEMS, THEIR DEVELOPMENT, USE AND APPLICATION (SELECTED ARTICLES)

E. A. Zhukovskaya et al 14 Oct. 1970 38 p refs Transl. into ENGLISH from the publ. 'Informatsionno-Poiskovyye Sistemy, Ikh Razrabotka i Primeneniye' USSR, 1969 p 32–50 and 82–84

(AD-716521; FTD-HC-23-533-70) Avail: NTIS CSCL 5/2

Contents: Possibilities for using information retrieval systems in geology; Information retrieval system for centralized record keeping for oncological patients. GRA

N71-19728# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

DESIGN OF GEOMORPHOLOGICAL-TOPOGRAPHIC MAP FOR WESTERN MIDDLE EUROPE 1/1 MILLION [ENTWURF EINER GEOMORPHOLOGISCHEN UEBERSICHTSKARTE DES WESTLICHEN MITTELEUROPA 1/1 MILLION]

Gustav Neugebauer (Ph.D. Thesis – Ludwig-Maximilians-Univ.) 1970 117 p refs In GERMAN

Avail: NTIS

The construction of a geomorphlogical map for a complex area of Middle Europe is performed by combining relief groupings into larger units that display regional types of morphological formations. Effective reliefs are obtained by height scaling of topographic values in the surface signatures so that the lowest areas exhibit the least and the highest areas the most shading values. Singular formations are represented by planimetric and vertical projection signatures. A topographic-hydrographic reference base is incorporated through reproduction of the water net, the most important settlements, and the graded index of the topographic map 1:25,000. Four large cutouts of the 1:1 million map are shown that include all types of large area topographic varieties represented in the master map. Transl. by G.G.

N71-19732*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

REGIONAL SIGNIFICANCE OF VOLCANIC GEOCHEMISTRY IN THE FAR TRIPLE JUNCTION, ETHIOPIA

P. A. Mohr Feb. 1971 23 p refs

(Grant NGR-09-015-002)

(NASA-CR-117136) Avail: NTIS CSCL 08E

Progressive changes in volcanic chemistry along a traverse across the Arabo-Ethiopian swell suggest a shallowing of the zone of melting with concomitant crustal thinning from plateau to rift. The gradational nature of this thinning seems to exclude a predrift fitting of the Red Sea coastal escarpments and accords with geological evidence for extension of continental crust beyond the escarpments into the rift zone. Author

N71-19758# Physikalisch-Meteorologisches Observatorium, Davos (Switzerland).

MEASURED AND THEORETICAL VALUES OF THE SPECTRAL INTENSITY OF ULTRAVIOLET ZENITH RADIATION AND DIRECT SOLAR RADIATION AT 316, 1580 AND 2818 m a.s.l. Final Scientific Report, 1 Jan. 1967–31 Dec. 1969

Paul Bener Jul. 1970 303 p refs

(Contract F61052-67-C-0029)

(AD-716535; AFCRL-70-0601) Avail: NTIS HC $6.00/MF $0.95

Measurements of zenith intensity of the clear sky and of direct solar intensity have been taken for selected wavelengths between lambda = 297.5 and 400 nm at Biel, Davos and Weissfluhgipfel. A spectrophotometer described has been used. The ratio between the intensity of sky brightness and direct solar radiation is examined. The measured data, partly interpolated for round values of solar altitude, and the mean values averaged over all results obtained for a given elevation are presented in tables and discussed. The apparent values of extraterrestrial solar intensity and of optical thickness for extinction and aerosal scattering are tabled and analyzed. Theoretical values of intensity for a Rayleigh atmosphere have been included into the tables to facilitate a comparison with measured data. A satisfactory agreement with theory is obtained, if measured and theoretical values of zenith intensity (for lambda = or > 330 nm) are examined in dependence on the measured values of optical thickness of extinction (including Rayleigh and aerosal scattering) for the days in question. Author (GRA)

N71-19770# Systems Research Corp., Washington, D.C.

NAVAL SURFACE SHIP ARCTIC MISSIONS. VOLUME 2.

APPENDIX A: ARCTIC RESOURCES

L. C. Van Allen, D. M. Tyree, and G. S. Sexton 18 Dec. 1970 128 p refs

(Contract N00014-70-C-0323)

(AD-716415; SRC-70-TR-N3001-Vol-2-App-A) Avail: NTIS CSCL 8/7

Contents: U.S. Arctic resources; (Population, industries, fuel, coal, petroleum, transportation); Canadian Arctic resources; (Population, natural resources, industries, transportation); U.S.S.R. Arctic resources; (Population, industries, fuel, transportation); Scandinavian Arctic resources; and Greenland Arctic resources. GRA

N71-19771# Systems Research Corp., Washington, D.C.

NAVAL SURFACE SHIP ARCTIC MISSIONS. VOLUME 3: ENVIRONMENT OF THE ARCTIC OCEAN AND THE RIMLAND

J. E. Sater 18 Dec. 1970 326 p refs Prepared by Arctic Inst. of North Am., Washington, D.C.

(Contract N00014-70-C-0323)

(AD-716416; SRC-70-TR-N3001-App-B-Vol-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 8/6

The report describes the environment and character of the Arctic Basin and its near-shore areas as well as those of the North Atlantic and North Pacific and their shores. The description is directed to the marine environment and to operations in that sphere. The work was conducted by The Arctic Institute of North America to support the analyses of Naval Surface Ship Arctic Missions. Author (GRA)

N71-19894# Louisiana State Univ., Baton Rouge. Coastal Studies Inst.

OCEANOGRAPHIC OBSERVATIONS AND THEORETICAL ANALYSIS OF OIL SLICKS DURING THE CHEVRON SPILL, MARCH 1970 Final Report, Mar.–Jul. 1970

Stephen P. Murray, W. G. Smith, and Choule J. Sonu Jul. 1970 114 p refs

(Contract DOT-CG-03592-A)

(AD-716324; Rept-714104/A/006-2) Avail: NTIS CSCL 13/2

The report discusses oceanographic observations near the Chevron spilling well off the Mississippi Delta in March 1970 and relative roles of various physical factors of the regional estuarine system in the behavior of oil slicks. Author (GRA)

N71-19908# Naval Civil Engineering Lab., Port Hueneme, Calif.

SNOW COMPACTION: INVESTIGATION OF METAMORPHISM OF SNOW Final Report, Jun. 1968–Jun. 1970

N. S. Stehle Dec. 1970 31 p refs

(AD-716417; TR-706) Avail: NTIS CSCL 8/12

Although processing and compacting increase the density and bearing capacity of surface snow for use as roads and trails, these processes have not been able to achieve the degree of densification that occurs naturally as snow slowly metamorphoses to glacier ice. A study was made at the Naval Civil Engineering Laboratory of the processes and influences of the major mechanisms that control snow metamorphism--grain size, pressure, temperature and solar radiation--in order to provide a basis for developing better techniques for higher strength snow pavements. It was concluded that maximum snow strengths are achieved at or near a critical density of 60 gm/cu cm, followed by bond growth, or age hardening, at temperatures between -12C and -7C. In addition, as distribution of applied loads with depth is essential to the development of operational criteria for such pavements, it is recommended that research be conducted to develop this knowledge. Author (GRA)

N71-19909# Naval Oceanographic Office, Washington, D.C.

GEOMORPHOLOGY AND MORPHOMETRIC CHARACTERISTICS OF A PART OF THE ARABIAN–INDIAN RIDGE [GEOMORFOLOGIYA I MORPHOMETRICHESKIE KHARAKTERISTIKI UCHASTKA ARAVIISKO–INDIISKOGO KHREBTA]

L. B. Lisnyanskaya 1970 18 p refs Transl. into ENGLISH from Okeanologicheskie Issled. (Moscow), no. 19, 1968 p 189–194

(AD-716271; NOO-Trans-521) Avail: NTIS CSCL 8/10

The central part of the Arabian-Indian Ridge is discussed in detail. The rugged and diverse bottom relief with peaks, conic mounds, depressions, trenches and valleys of various forms and sizes is presented on geomorphological and bathymetric charts. Author (GRA)

N71-19910# Naval Oceanographic Office, Washington, D.C.

THE SMOOTHING OF RESULTS OF OCEANOGRAPHIC OBSERVATIONS [SGLAZHIVANIE REZULTATOV OKEANOGRAFICHESKIKH NABLYUDENII]

M. N. Koshlyakov 1970 16 p refs Transl. into ENGLISH from Okeanologiya (USSR), v. 4, no. 3, 1964 p 488–496

(AD-716272; NOO-Trans-524) Avail: NTIS CSCL 8/10

The calculation and reliability of various smoothing methods are discussed by analyzing various formulae. It is established that the results of direct observations, such as density distribution in ocean water, must be properly smoothed to arrive at reliable data. In addition the spacing of observation stations that gather the needed data must be coordinated with hydrological conditions in the given region. The maximum spacing of stations is 150km, but in areas crossed by strong currents, such as the Gulf Stream or Kuroshio, the spacing should be much smaller. A special method for averaging observed hydrological distributions is analyzed. Author (GRA)

N71-20047# National Physical Lab., New Delhi (India). Radio Science Div.

CHARACTERISTICS OF LARGE SCALE IONOSPHERIC IRREGULARITIES DERIVED FROM FARADAY ROTATION MEASUREMENTS

Tuhi Ram Tyagi, Y. V. Somayajula, Sant Prakash (Kurukshetra Univ.), and J. B. Lal (Kurukshetra Univ.) Jun. 1970 24 p refs

(RSD-553) Avail: NTIS

The Faraday fadings of 40 MHz transmissions from Explorer 22 were recorded at two stations, Delhi and Kurukshetra, 160 km apart along a N-S baseline, from June 1968 to April 1969 and were used to study the large scale irregularities of the ionosphere. The content of the irregularities vary from 4×10 to the 14th power to 1.2×10 to the 16th power e/sq m. The height of irregularities varied from 230 to 710 km, the most common height being 350 km. The horizontal size was found to range from 10 to 250 km. The content of the irregularities was independent of their size. The size as well as content of the irregularities showed no correlation with latitude or earth's magnetic field. It is found that the irregularities are not field aligned in contrast to the small scale irregularities which are reported to be field aligned. Author

N71-20083# Techtran Corp., Glen Burnie, Md.

THE HEAT FIELD AND ABYSSAL STRUCTURE OF THE EASTERN CARPATHIANS [TEPLOVOYE POLE I GLUBINNOYE STROYENIYE VOSTOCHNYKH KARPAT]

R. I. Kutas et al Washington NASA Mar. 1971 18 p refs Transl. into ENGLISH from Geofiz. Sbornik (USSR), no. 34, 1970 p 29–41

(Contract NASw-2037)

(NASA-TT-F-13517) Avail: NTIS CSCL 08G

The results are presented of a study of the heat flux in 43 bore holes over the southwestern slope of the Ukrainian Shield, the L'vov Paleozoic, Precarpathian and Transcarpathian depressions and the folded Carpathians. A determination of the heat flux is given along with an analysis of the abyssal heat flux distribution in relationship to the tectonics and geological development of the region. Author

N71-20149# Tel-Aviv Univ. (Israel). Dept. of Environmental Sciences.
DEPARTMENT OF ENVIRONMENTAL SCIENCES Research Report, 1969
1969 80 p
Avail: NTIS

Scientific activity is reported within the department of environmental sciences which encompasses the areas of solid earth geophysics, seismology, oceanography, earth resources, atmospheric motions, ionospheric physics, and solar-terrestrial interactions including magnetospheric physics and the solar wind. Abstracts of scientific publications by various members of the department during 1969 are appended. Author

N71-20164*# Techtran Corp., Glen Burnie, Md.
STUDY OF THE INFLUENCE OF HIGH PRESSURES AND TEMPERATURES ON VELOCITY OF ELASTIC WAVES IN CERTAIN ROCKS OF THE UKRAINIAN SHIELD [IZUCHENIYE VLIYANIYE VYSOKIKH DAVLENIY I TEMPERATUR NA SKOROST' UPRUGIKH VOLN V NEKOTORYLCH PORODAKH UKRAINSKOFO SHCHITA]
T. S. Lebedev et al Washington NASA Mar. 1971 18 p refs Transl. into ENGLISH from Geofiz. Sbornik (USSR), no. 32, 1969 p 5–15
(Contract NASw-2037)
(NASA-TT-F-13516) Avail: NTIS CSCL 08K

The simultaneous influence of high pressure and temperature on longitudinal wave velocity in rock specimens was studied using a high quasihydrostatic pressure installation. During the first stage of heating (up to 100 C), a general decrease in velocity is observed, primarily as a result of intensive evaporation of water. With further heating, jointing is less significant than in specimens not subjected to high pressure. This results in some smoothing of the curves at high pressures. Further increases in temperature cause the process of crack formation to continue, resulting in a further slight decrease in velocity. Author

N71-20186# Commissariat a l'Energie Atomique, La Hague (France). Section de Protection contre les Radiations.
EVALUATION OF ATMOSPHERIC CONTAMINATION BY PLUTONIUM WITH DISCRIMINATION OF THE NATURAL ACTIVITY [EVALUATION DE LA CONTAMINATION ATMOSPHERIQUE PAR DU PLUTONIUM AVEC DISCRIMINATION DE L'ACTIVITE NATURELLE]
Albert Clech and Rene Prevot Mar. 1969 18 p refs In FRENCH
(CEA-R-3701) Avail: AEC Depository Libraries

The application of aerosol sampling methods using two filters of different stopping powers, for the discrimination of natural activity was evaluated. The experimental results were used to construct charts to evaluate atmospheric contamination by plutonium and calculate the margin of error. Author (NSA)

N71-20217# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).
REAL TIME SIMULATION OF ATMOSPHERIC BALLOON ENVIRONMENT
A. J. Paillous and M. Roussel *In* NBS Space Simulation Oct. 1970 p 245–259 refs Sponsored by CNES (See N71-20201 09-11)
Avail: SOD $5.25

A simulation chamber was designed in order to study the behavior of several balloon materials during long time flights. Solar ultraviolet radiation, pressure, temperature and atmospheric composition are the simulated constituents of the atmospheric balloon environment. Samples are irradiated without mechanical strain. A computer program, taking the values of different parameters against wavelength into account, gives the information for conducting the simulation. Experiments are performed in realtime. Exact ultraviolet energy doses, in each spectral wavelength interval, between 300 and 410 nm, are delivered every day to samples. A night-day cycle is simultaneously achieved with a thermal cycle. Author

N71-20284*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE RESPONSE OF THE THERMOSPHERIC DENSITY TO AURORAL HEATING DURING GEOMAGNETIC DISTURBANCES
H. Volland and H. G. Mayr Jan. 1971 38 p refs Submitted for publication
(NASA-TM-X-65462; X-621-71-57) Avail: NTIS CSCL 03B

Assuming an impulse type heat input into a small band of latitude within the aurora ovals during local night (simulating a heat input during geomagnetic disturbances), the corresponding response of the thermospheric density was calculated. The result interms of a series of spherical harmonics shows that the components with large wave domain numbers (n,m) decay rapidly within the first hour after the onset of the geomagnetic storm while the two zonal components (0,0) and (2,0) and the two associated components (1,1) and (3,1) are predominant during the slow tail phase of the disturbance. It is that slow tail of the density disturbance beginning about one hour after the onset of the storm which contains most of the spectral energy and which is responsible for the observed world wide response of the thermospheric density during geomagnetic storms. Its dependence on storm time, latitude, and longitude is discussed and compared with available satellite drag data. Author

N71-20285*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROPAGATION DELAY IN THE ATMOSPHERE
David M. LeVine (Md. Univ., Coll. Park) Nov. 1970 54 p refs Submitted for publication
(NASA-TM-X-65460; X-521-70-404) Avail: NTIS CSCL 04A

The structure of the lower atmosphere and the ionosphere are discussed and an introduction to ray tracing in the atmosphere is given. Models for each region appropriate for satellite-to-earth communication in the frequency range 1 to 15 GHz are discussed. Assuming a spherically symmetric atmosphere, propagation delay is computed for the lower atmosphere and for the ionosphere. The total atmospheric delay is also computed as a function of atmospheric conditions, frequency, and altitude of the signal source. Author

N71-20287# Shannon and Wilson, Inc., Seattle, Wash.
SOIL BEHAVIOR UNDER EARTHQUAKE LOADING CONDITIONS, REVISED PROGRAM DEFINITION
6 Nov. 1970 28 p Sponsored in part by ORNL Prepared in cooperation with Agbabian-Jacobsen Associates, Los Angeles
(TID-25580) Avail: NTIS

The technical approach and schedule for a study of methods to predict the behavior of soils at nuclear power plant sites under earthquake loading conditions are presented. The project schedule includes tasks to be undertaken over 3 1/2 years. NSA

N71-20289*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STUDIES OF POSITIVE ION COMPOSITION IN THE EQUATORIAL D-REGION IONOSPHERE
R. A. Goldberg and A. C. Aikin Feb. 1971 39 p refs Submitted for publication
(NASA-TM-X-65464; X-625-71-73) Avail: NTIS CSCL 03B

Two daytime D region positive ion composition measurements at Thumba, India are presented for solar zenith angles of 53.2 and 27.8 deg. Comparison of upleg ram with downleg wake data shows a large increase in the concentration of heavy ions 48(+), NO(+)·H2O; 55(+), H3O(+)·(H2O)2; and M(+)> 65(+) for the

downleg reduced shock condition. Peak concentrations of 48(+) and 55(+) occur at unit optical depth for Lyman alpha radiation. The ion 37(+), H3O(+)·H2O, is dominant for chi = 27.8 deg but not for chi = 53.2 deg, consistent with an origin from the X-ray production of O2(+). It is shown that NO(+) ions can be transferred to heavy hydrates 48(+), 55(+), and M(+)> 65(+) by a reaction chain starting with NO(+) + X + M = NO(+)·X + M where X can be O2, N2, CO2, or a combination of all three depending on the rate of reaction. This chain, together with a similar reaction scheme starting with O2(+) and ending in 19(+) and 37(+), leads to a consistent explanation for the hydrated ions observed in the D region. Author

N71-20283# Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes.
SEISMIC STUDIES OF NUCLEAR EXPLOSIONS. MEASUREMENT METHODS [ETUDE SEISMIQUE DES TIRS NUCLEAIRES METHODES DE MESURE]
Francoise Duclaux Nov. 1970 25 p refs In FRENCH
(CEA-R-4091) Avail: AEC Depository Libraries

After reviewing the different methods used in other countries for the seismic studies of underground nuclear explosions, the method employed in the Sahara for fifty km around ground zero is discussed. Comparison of these different methods shows many similarities. The methods used in other countries are noticeable for their size and the importance of the means used. In the Sahara, the technology is characterized by a great concentration of devices for measuring around ground zero. Author (NSA)

N71-20294*# Translation Consultants, Ltd., Arlington, Va.
THE RATE OF PROPAGATION OF ULTRASONIC WAVES IN HUNGARIAN ROCKS, AND ITS CORRELATION WITH OTHER PHYSICAL AND CHEMICAL ROCK CHARACTERISTICS [HAZAI KOZETEKBEN ULTRAHANGGAL MEGHATAROZOTT SEBESSEGERTEKEKNEK ES EGYEB FIZIKAI, KEMIAI JELLEMZOINEK OSSZEFUGGESE]
P. Ottlik Washington NASA Mar. 1971 21 p refs Transl. into ENGLISH from Geofiz. Kozlemen. (Budapest), v. 12, no. 3–4, 1963 p 85–100
(Contract NASw-2038)
(NASA-TT-F-13477) Avail: NTIS CSCL 08G

An ultrasonic laboratory method for establishing the rate at which elastic waves are propagated in a number of carbonaceous rocks (mainly limestones), as well as in some siliceous rocks, is discussed. The relationship between velocity and physical and chemical characteristics of these rocks is explained. Further research is required in order to explain the principles underlying the difference between results obtained in the laboratory and those obtained under field conditions. Author

N71-20300*# Translation Consultants, Ltd., Arlington, Va.
THE ELASTIC PROPERTIES OF ALKALI SYENITES FROM THE OCTOBER MASSIF [UPRUGIYE SVOYSTVA SHCHELOVHNYKH SIYENITOV OKTYABR'SKOGO MASSIVA]
A. Ya. D'yachkova et al Washington NASA Mar. 1971 9 p refs Transl. into ENGLISH from Geofizicheskiy So. Inst. Geofiziki, Akad. Nauk, UkSSR (Sbornik), no. 17, 1966 p 81–85
(Contract NASw-2038)
(NASA-TT-F-13549) Avail: NTIS CSCL 08G

Data are presented on the elastic properties of alkali syenites obtained by laboratory studies made of core samples from the October Massif using an ultrasonic method. Author

N71-20301*# Scientific Translation Service, Santa Barbara, Calif.
INJECTION OF HIGH-ENERGY ELECTRONS INTO THE INNER REGIONS OF THE MAGNETOSPHERE DURING THE MAGNETIC STORM OF 29 OCTOBER 4 NOVEMBER 1968 [INZHEKTSIYA ENERGICHNYKH ELECKTRONOV VO VNUTRENNIYE OBLASTI MAGNITOSFERY VO UREMYA MAGNITNOY BURI 29.X–4.XI. 1968 G.]
S. N. Vernov et al Washington NASA Mar. 1971 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 34, no. 11, 1970 p 2270–2274
(Contract NASw-2035)
(NASA-TT-F-13512) Avail: NTIS CSCL 03B

Electron fluxes were measured on Molniya 1 during a magnetic storm. The causes of the advance of the injected electron front are not reliably established. Author

N71-20344*# Scripta Technica, Inc., Washington, D.C.
TRAVELING DISTURBANCES IN THE IONOSPHERIC F REGION AND THE SPORADIC E REGION [PEREMESHCHAYUSHCHIYESYA VOZMUSHCHENIYA V F OBLASTI IONOSFERY I SPORADICHESKIY SLOY E]
Z. S. Sharadze NASA Mar. 1971 14 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gorkiy), v. 13, no. 7, 1970 p 1001–1011 Presented at the All Union Ionospheric Conf., Leningrad, 1968
(Contract NASw-2036)
(NASA-TT-F-13483) Avail: NTIS CSCL 04A

An investigation of traveling disturbances over Tbilisi for the period 1964–1967 is reported. The relationship between TD and E sub s is analyzed. It is shown that TDs can be associated with the propagation of internal gravity waves in the ionosphere. Author

N71-20345# National Physical Lab., New Delhi (India). Radio Science Div.
SOME OBSERVATIONS OF TOTAL ELECTRON CONTENT MEASUREMENTS DURING MAGNETIC STORMS IN EQUINOCTIAL MONTHS
Sant Prakash (Kurukshetra Univ.), J. B. Lal (Kurukshetra Univ.), and B. M. Reddy Jun. 1970 21 p refs
(RSD-54) Avail: NTIS CSCL 03B

Total electron content (Nt) measurements derived by recording the beacon transmissions from Explorer 22 satellite are reported for some magnetically active periods. The total content values, along with foF2 values from an ionosonde are compared with the magnetic activity. N sub t always shows varying degrees of enhancement; depression of N sub t below normal was not observed during any phase of the storm. This behavior is inconsistent with mere vertical redistribution of ionization. Author

N71-20346*# Techtran Corp., Glen Burnie, Md.
ELASTIC PROPERTIES AND WATER ABSORPTION OF ROCKS ACCORDING TO SONIC LOGGING [UPRUGIYE SVOYSTVA I VODOPOGLOSHCHENIYE GORNYKH POROD PO DANNYM SEYSMOKAROTAZHA]
O. K. Voronkov et al Washington NASA Mar. 1971 13 p refs Transl. into ENGLISH from Uch. Zap., Ser. Fiz. i Geol., Nauk (USSR), v. 17, no. 333, 1967 p 164–172
(Contract NASw-2037)
(NASA-TT-F-13532) Avail: NTIS CSCL 08G

A six element array of geophones and a seismometer were employed in a study of the structure and changes in the properties of fractured rock in natural stratification. The data permitted conclusions about the elastic properties over a distance and about the suitability of the rocks as foundations for large engineering structures. They also exposed sectors of rock with varying degrees of fracturing and permitted evaluation of the total porosity of the rocks. Comparison of the specific water absorption of various types of rock (shales, granites, tufaceous sandstones and limestones) with the compression and shear wave velocities shows that the theoretical relationship agrees satisfactorily with the observations. Author

N71-20422*# Texas A&M Univ., College Station. Dept. of Oceanography.
OCEANOGRAPHIC EXPERIMENT SUPPORT: REMOTE

SENSING OF COASTAL OCEANS Annual Report, May 1969 – May 1970
10 May 1970 143 p refs
(NASA Order W-12879; Contract N62306-69-C-0263)
(NASA-CR-117316) Avail: NTIS CSCL 08C

The status of microwave radiometry uses in making meaningful oceanographic observations is summarized. Plans for international cooperative oceanographic expeditions are cited including measurement of biomass production and associated phenomena in the marine environment. An analysis of data recorded on ships and NASA aircraft missions around Veracruz, Mexico is presented. Color, false color infrared, and multiband photography in four spectral bands and infrared imagery from aircraft flights over Cabo Frio, Brazil are analyzed. Oceanographic features observed in Apollo 9 photographs are outlined as well as upwelling detection from space photography. J.M.

N71-20426*# Scientific Translation Service, Santa Barbara, Calif.
ARTIFICIAL SOILS BASED ON ION-EXCHANGE MATERIALS [ISKUSSTVENNYE POCHVI NO OSNOVE IONOOBMENNYKH MATERIALOV]
V. S. Soldatov et al Washington NASA Mar. 1971 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk BSSR (Belorussian SSR), v. 12, no. 4, 1968 p 357 – 359
(Contract NASw-2035)
(NASA-TT-F-13543) Avail: NTIS CSCL 08M

A mixture consisting of anion-exchange and cation-exchange resins (exchange capacity of both resins 4 to 5 equivalents/kg) was tested for the cultivation of various vegetables and flowers. The resin mixture was treated with a nutrient salt solution that gave good results in hydroponic systems. Growth and development of the plants on this substrate were better than on a natural fertile soil or sand cultivation. The substrate permits the growth of several plant generations without subsequent top-dressing and regeneration of the resin mixture. Author

N71-20591# Travelers Research Corp., Hartford, Conn.
ANALYSIS OF THE EFFECT OF TERRAIN IRREGULARITIES ON TURBULENCE AND DIFFUSION IN THE SURFACE BOUNDARY LAYER Final Report
Norman E. Bowne, Herbert D. Entrekin, and Gerald E. Anderson Oct. 1970 148 p refs
(Contract AT(30-1)-4140)
(NYO-4140-1) Avail: NTIS

Wind and temperature fluctuation data were collected in conjunction with a diffusion program through wooded areas in north central Arkansas. The meteorological data are examined and compared to existing theories of boundary layer turbulence and turbulence data collected at other sites. Even though the surface is not homogeneous and evidence of the effect of changing surface characteristics can be found in the data, general universal functions and relationships predict the intensity of longitudinal and lateral turbulence with skill. Vertical turbulence was not as great as predicted by similarity theory and associated constants. This is attributed to the damping effect of the surface and vertical thermal stability during the observational periods. Spectrum analysis of the wind components and temperature fluctuation revealed that eddy energy was spread over a wide range of frequencies as expected and that peaks in the spectra occurred at highest frequency for vertical velocity, at lower frequency for lateral and longitudinal components, and finally the temperature peak nearly an order of magnitude lower than the wind components. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N71-19384# Industrial Nucleonics Corp., Columbus, Ohio.
DEVELOPMENT AND TESTING OF ISOTOPIC SHOCK-WAVE POSITION SENSOR Final Report
John P. Scheiwe and David E. Creasman 5 Jun. 1970 188 p refs
(Contract AT(30-1)-4071)
(NYO-4071-1) Avail: NTIS

The design and test of a nucleonic shock-wave position sensor are discussed. The design incorporated three Kr-85 radiation sources and three ionization chamber detectors to measure the air density upstream of, through and downstream of the shock wave. The upstream and downstream measurement were used to eliminate sensitivity to Mach number and total static pressure changes. The results of two test programs, which demonstrated the sensitivity of the system to shock-wave position, are shown. Bremsstrahlung crosstalk and calibration were two problems encountered, and the methods for elimination of these problems are discussed. Author (NSA)

N71-19430# State Inst. for Technical Research, Helsinki (Finland).
APPARATUS FOR DC MEASUREMENTS OF HALL AND PHOTO-HALL EFFECT IN HIGH RESISTIVITY SEMICONDUCTORS
E. Aminoff and J. Heleskivi 1970 19 p refs
Avail: NTIS

An apparatus was constructed for dc Hall and photo-Hall effect measurements in high resistivity semiconductors, within the temperature range of 77 to 350 K, and the photon energy range 0.5 to 4.0 eV. The sample was furnished with only four contacts, two current contacts and two Hall contacts, since both compensation of the misalignment potential and measurement of the Hall voltage were performed with a single potentiometric electrometer. The apparatus is capable of measuring 100 microvolts Hall effects with an input resistance which always exceeds 10 to the 13th power ohms. Author

N71-19431* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
APPARATUS FOR MEASURING CURRENT FLOW Patent
John Paulkovich, inventor (to NASA) Issued 14 Jan. 1969 (Filed 14 Sep. 1965) 8 p Cl. 324-120; Int. Cl. G01r19/26; Int. Cl. G01r33/00
(NASA-Case-XGS-02439; US-Patent-3,422,352; US-Patent-Appl-SN-487341) Avail: US Patent Office CSCL 09A

An apparatus for electric current measurement is described which provides an accumulated output of the total current measured over a time interval. The use of a saturable core transformer in which errors due to the magnetizing currents in the transformer output winding are avoided by isolating the output with an energy storage device. Official Gazette of the U.S. Patent Office

N71-19483 Texas Technological Coll., Lubbock.
X-RAY LINE WIDTH MEASUREMENTS WITH A THREE CRYSTAL SPECTROMETER
Herbert Eugene Welch (Ph.D. Thesis) 1969 108 p
Avail: Univ. Microfilms: HC $5.40/Microfilm $3.00 Order No. 70-1483

The K alpha spectra of the elements Cu, Ag and Mo were studied with two- and three-crystal spectrometers. The widths of the K alpha lines of the elements are significantly less than previously reported. For example, the average width of the K alpha sub 1 line of Cu as reported by other observers is 2.97 volts before any correction is applied and 2.26 volts after correction. The Cu K alpha sub 1 line width was measured to be 1.85 volts uncorrected and 1.64 volts after correction. The existence of sharp lines in the output of single- and double-crystal spectrometers operated near the Bragg angle for a characteristic spectral line of the target material was confirmed. It was predicted that this so-called coherent crystal radiation, or CCR, would influence the measurement of

X-ray line widths. The predictions are confirmed and methods for studying the widths and shapes of X-ray spectral lines which reduce the effects of the CCR to a minimum are presented. Dissert. Abstr.

N71-19568* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

SOLAR OPTICAL TELESCOPE DOME CONTROL SYSTEM

Patent

Kenneth D. Cashion, inventor (to NASA) Issued 7 Jan. 1969 (Filed 31 Aug. 1967) 6 p Cl. 250-203; Int. Cl. G01j1/20; Int. Cl. G01c17/34; Int. Cl. G01c21/02

(NASA-Case-MSC-10966; US-Patent-3,421,004; US-Patent-Appl-SN-665676) Avail: US Patent Office CSCL 14B

A dome control system utilizes sun vanes mounted externally of the dome. The vanes are placed so as to keep two cadmium selenide cells in the shadow when the sun is shining through the shutter of the dome. At a predetermined time, the dome shutter will open and a telescope will start tracking. When the sun illuminates the dome, the dome will rotate until the sun illuminates the telescope. As the sun approaches the western edge of the shutter, the shadow line of the sun vanes begin to illuminate the western cell which starts the dome to rotate to the west until the dome illuminates the eastern cell which stops the dome rotation. Means are also provided so that should the sun be obscured by the clouds, the dome does not rotate until the sun reappears; then the dome will rotate until it is properly aligned with the sun. Official Gazette of the U.S. Patent Office

N71-19576# Naval Ordnance Lab., White Oak, Md.

A FINE WIRE STAGNATION TEMPERATURE PROBE

William J. Yanta 15 Jun. 1970 33 p refs

(AD-716022; NOLTR-70-81) Avail: NTIS CSCL 14/2

A temperature probe using a small thermocouple wire with its axis placed normal to an airstream was designed, built and tested. The primary purpose of the probe is to measure the stagnation temperature distribution through a supersonic turbulent boundary layer. The small probe size permits measurements in the laminar sublayer region. The probes simple geometric shape and design provides simplicity in determining the local gas temperature. Experiments were made to measure the local stagnation temperature of the flow with an accuracy of 5R over a moderate temperature range of 560R to 780R. Author (GRA)

N71-19699*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A REVIEW OF THE MASS-FLUX PROBE

Lloyd N. Krause and George E. Glawe [1971] 28 p refs Proposed for presentation at the 1971 Symp. on Flow, its Meas. and Control in Sci. and Ind., Pittsburgh, 9 – 14 May 1971

(NASA-TM-X-52974; E-6180) Avail: NTIS CSCL 14B

The mass-flux probe is studied as a useful diagnostic tool in high Mach number and high enthalpy flows. The factors discussed which affect the probe performance and operation include: inlet contraction ratio, shape, size, bluntness, and angle of attack. F.O.S.

N71-19703*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SMALL TURBINE-TYPE FLOWMETERS FOR LIQUID HYDROGEN

I. Warshawsky, H. F. Hobart, and H. L. Minkin [1971] 28 p refs Proposed for presentation at 1971 Symp. on Flow: Its Meas. and Control in Sci. and Industry, Pittsburgh, 9 – 14 May 1971

(NASA-TM-X-52984; E-6210) Avail: NTIS CSCL 14B

Statistical data are presented on the reproducibility and linearity of turbine-type sensors, in 2 to 5 cm sizes, with various types of bearings. Design principles; installation practices, and inspection procedures are suggested that are conducive to reliability. The efficacy of room-temperature calibration with water or high-pressure nitrogen gas is also considered. Actual calibration in liquid hydrogen is required to identify meters of good quality (calibration reproducibility with less than 0.3% probable error) and to establish the mean calibration curve with minimum error. Designs operating at fluid velocities up to 30 m/sec can yield a calibration factor that is constant to 0.5% over a 10:1 flow range. Author

N71-19752*# Matrix Research, Falls Church, Va.

HEAD-UP DISPLAYS: A STUDY OF THEIR APPLICABILITY IN CIVIL AVIATION

Larry L. Jenney, Thomas B. Malone, and George A. Schweickert 8 Jan. 1971 326 p refs

(Contract NASw-1940)

(NASA-CR-117135) Avail: NTIS HC $6.00/MF $0.95 CSCL 14B

Research literature, published commentary, and supplementary information on the subject of aircraft operating problems and the head-up display are analyzed. The device presents information as a collimated image in such a way that the pilot views the display and looks out the window at the same time. The general requirements governing the display's acceptance are identified as safety, practicality, and economy. The greatest potential contribution is in approach and landing. The pilot's task and his guidance and control problems are analyzed, along with takeoff, missed approach, and taxiing in very low visibilities. The pilot's visual tasks are described in detail, and present aids and solutions to these problems and their shortcomings are examined. The applicability and usefulness of the head-up display in solving these problems are outlined. The technical and practical problems which must be solved before the display can gain final acceptance in civil aviation are classed as technological, human factors, doctrinal, and commercial. It is concluded that the potential value of the display justifies the effort necessary to resolve implementation problems. N.E.N.

N71-19795*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

IN-SITU MEASUREMENT OF OBJECTIVE LENS DATA OF A HIGH-RESOLUTION ELECTRON MICROSCOPE

Klaus Heinemann Feb. 1971 34 p refs

(NASA-TM-X-62018) Avail: NTIS CSCL 14B

Bragg-reflex images of small individual crystallites in the size range of 20 to 100 diameter with known crystallographic orientation were used in a transmission electron microscope to determine in-situ: (1) the relationship between objective lens current (or accelerating voltage) changes in discrete steps and corresponding defocus, (2) the spherical aberration coefficient, and (3) the axial chromatic aberration coefficient of the objective lens. The accuracy of the method is better than 5%. The same specimen can advantageously be used to properly aline the illuminating beam with respect to the optical axis. Author

N71-19870# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

A PORTABLE STATION FOR RECORDING FIRE WEATHER DATA

John R. Murray and Clive M. Countryman 1968 7 p refs

(PSW-182) Avail: Issuing Activity

A portable station for recording fire weather data was developed for use in wildland fires, prescribed burns, evaluating sites for fire weather stations, and fire research. Housed in a mechanic's tool box, the station weighs about 60 pounds. One man can have it ready to operate in about 15 minutes. The unit can record five weather variables, but additional data can be recorded by modifying the electronic circuitry. Data are recorded on strip chart recorders. Author

N71-19932*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

THIN FILM PENETRATION BY HYPERVELOCITY MICROPARTICLES

Anthony R. Lewis and Robert A. Walter Washington Mar. 1971 9 p refs

(NASA-TM-X-2065; C-137) Avail: NTIS CSCL 14B

Carbonyl iron microparticles were accelerated electrostatically to velocities up to 25 km/s. Particles with selected velocities were impacted on thin parylene films mounted on 100-mesh electron microscope grids. The ratio of average hole-diameter to average particle-diameter increases from 1 to 7 as the velocity increases from 2 to 20 km/s. Particles whose diameters are greater than the film thickness punch a hole through the film whereas particles whose diameters are less than the film thickness break up during the impact interaction and thus enlarge the hole diameter beyond the particle diameter. Author

N71-19987*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

MSC APOLLO 13 INVESTIGATION TEAM. Panel 4: PHOTO HANDLING, PROCESSING, AND CATALOGUING Final Report

18 May 1970 7 p

(NASA-TM-X-68931) Avail: NTIS CSCL 14B

Photography of the failure of the Apollo 13 command service module is discussed. The cameras used, results obtained, and photographic processing procedures are described. Author

N71-20002# Advisory Group for Aerospace Research and Development, Paris (France).

A LITERATURE SURVEY ON THE GYROSCOPE AND ITS APPLICATIONS

Helmut Sorg (Stuttgart Univ.) Feb. 1971 23 p refs

(AGARD-582-71) Avail: NTIS

A consolidated listing is presented of all known unclassified texts which are readily available to scientists and engineers from commercial sources, documentation centers and public as well as corporate libraries. Each entry cites the author, publication year, title, documentation center source and a brief abstract of the work. Author

N71-20070*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.

FUNDAMENTAL SPECTROPHOTOMETRY OF THE MAJOR PLANETS Progress Report, 1 Jun. 1970 – 1 Feb. 1971

John S. Neff 25 Feb. 1971 17 p refs

(Grants NGR-16-001-094; NGL-16-001-002)

(NASA-CR-117058) Avail: NTIS CSCL 14B

A filter photometer employing a blue filter was modified to automatically switch between planet and sky. The data were automatically logged on paper tape for processing. The Pluto observations were obtained as part of a continuing program to improve the light curve; Uranus and Neptune observations were also obtained to search for rotational modulation of their light curves. A slit mask, an offset guider, and a solar attenuator for the rapid scanner were tested in the laboratory and on the telescope. A fast data logging system was designed, employing a digital tone system. J.A.M.

N71-20206# Atlantic Research Corp., Costa Mesa, Calif. Advanced Technology Group.

PARTICULATE CONTAMINANT MEASUREMENT BY QUARTZ CRYSTAL MICROBALANCE

R. L. Chaun *In* NBS Space Simulation Oct. 1970 p 105 – 111 (See N71-20201 09-11)

Avail: SOD $5.25

The QCM (quartz crystal microbalance) responds to a mass change on its surface by a change in crystal resonant frequency. This consideration lends itself to the sensitive and accurate measurement of discrete particulate mass, because when such a mass is deposited on the crystal there is an almost instantaneous, though small, frequency shift. By utilizing this very high rate of frequency shift it is possible to measure a single particulate of 2 micron diameter. In addition to measuring the mass of particulate matter, the technique also provides information on whether the material is volatile. Experimental data presented show the response of the QCM to non-volatile and volatile particulate matters. Author

N71-20209# McDonnell Aircraft Corp., St. Louis, Mo. Engineering Labs.

IN SITU VACUUM GAUGE CALIBRATION BY THE REFERENCE TRANSFER METHOD

L. D. Blado and R. H. Lilienkamp *In* NBS Space Simulation Oct. 1970 p 141 – 150 refs (See N71-20201 09-11)

Avail: SOD $5.25

Application of the reference transfer method to in situ calibration of ionization gauges was evaluated in order to ascertain the effectiveness of the method when applied in a manner determined both by the commercial availability of equipment and by the restraints of an operating space environment simulation facility. A prototype reference transfer calibrator was assembled from standard vacuum components. Transfer ratio determinations were made in the range 0.0001 to 10 to the minus 8th power torr. These experimental measurements were then compared with theoretical calculations, thereby verifying the feasibility of the technique. Author

N71-20258# Atomic Energy Establishment, Winfrith (England).

DEVELOPMENT OF HAMMER-SWAGED TRIAXIAL MINERAL INSULATED CABLES FOR USE WITH HIGH TEMPERATURE NEUTRON DETECTORS

K. W. McMinn Oct. 1970 6 p refs

(AEEW-R-698) Avail: AEC Depository Libraries

The development of a hammer-swaged mineral insulated cable suitable for use with high temperature neutron detectors is described. Typical properties of the cable are given together with points of interest in its development. Author (NSA)

N71-20259# National Research Council of Canada, Ottawa (Ontario).

ACCURACY IN MEASUREMENTS WITH STANDARD PLATINUM RESISTANCE THERMOMETERS [PRECISIONE NELLE MISURE CON TERMOMETRI CAMPIONE A RESISTORE DI PLATINO]

S. Sartori 1970 24 p refs Transl. into ENGLISH from Termotecnica (Milan), v. 21, no. 11, 1967 p 16 – 23

(NRC-TT-1427) Avail: NTIS

The instrument errors occurring in measurements of temperature are analyzed. The instrumentation includes measuring bridges, null indicators and thermometers. It is concluded that the major influence on the final accuracy lies in the thermometer, while the other instruments now permit accuracies that are limited only by the thermal noise. Author

N71-20260# National Research Council of Canada, Ottawa (Ontario).

BEHAVIOR OF PLATINUM RESISTANCE THERMOMETERS IN THE VICINITY OF 650 C [COMPORTAMENTO DI TERMOMETRI A RESISTORE DI PLATINO NELL INTORNO DI 650 C]

L. Crovini et al 1970 16 p refs Transl. into ENGLISH from Termotecnica (Milan), v. 21, no. 11, 1967 p 24 – 28

(NRC-TT-1428) Avail: NTIS

The behavior of standard platinum resistance thermometers subjected to operating cycles between 600 and 700 C is described. Both conventional thermometers with a resistance of 25.5 ohm at 0 C and specially constructed models with resistances below 2.5 ohm at 0 C are studied. The latter are shown to be superior to the former in this range of temperatures, as they have more stable and more easily measurable temperature characteristics. Author

N71-20262# National Research Council of Canada, Ottawa (Ontario).

LIMITS OF PRECISION OF THE MONOCHROMATIC PHOTOELECTRIC PYROMETER [LIMITI DI PRECISIONE DEL PIROMETRO FOTOELETTRICO MONOCROMATICO]

T. Ricolfi et al 1970 10 p refs Transl. into ENGLISH from Termotecnica (Milan), v. 21, no. 11, 1967 p 41–43
(NRC-TT-1430) Avail: NTIS

The advantages of replacing the visual pyrometer with a photoelectric one are outlined. The main components of the photoelectric pyrometer are examined and the contribution of each to the uncertainty in realizing the international practical temperature scale are discussed. Author

N71-20263# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.

AUTOMATIC METEOR REFLECTIONS RECORDING EQUIPMENT

Miodrag Lorencin Nov. 1970 65 p refs
(Rept-70-E-14) Avail: NTIS

The automatic meteor reflection recording equipment utilizes a coincidence circuit as well as a pulse accumulator. After analog/digital conversion, a digital system is applied to extract the data contained in the reflected echo. These data are: (1) real time of echo appearance; (2) echo duration; (3) signal strength (amplitude); and (4) range. Real time information is coded and punched out in the paper tape by the first puncher duty-cycle, and all other coded information is punched out by the second. The entire digital system is controlled by the control unit. Available information is transported via a buffer in the printout converter and after recoding is punched out in a tape enabling a digital computer to be used for final calculations. Author

N71-20264*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

A NOTE ON THE AUTOMATIC GENERATION AND RECOGNITION OF TEXTURES

Douglas W. Flower Washington Mar. 1971 17 p ref
(NASA-TN-D-5933; C-139) Avail: NTIS CSCL 14B

A simple algorithm for generating abstract textures by computer has been developed, wherein the visual appearance of a pure texture is produced by controlling the shape, color, and intersection properties of its component parts. The pure texture is subsequently transformed by superimposing noise, or by averaging adjacent points, or by accentuating boundaries. Textures were printed out using a character set which reasonably approximates eight equally separated gray levels when viewed as a gray wedge. A set of discriminators computed from the textures was used to analyze how well a pattern recognition scheme might be able to identify the various transformed versions of a given pure texture. Various entropy measures, as well as several indiced computed from the two-dimensional power spectrum, proved useful for this purpose. Author

N71-20285# California Univ., Livermore. Lawrence Radiation Lab.

MOISTURE PROTECTION OF STRAIN GAUGES [UEBER-DEN FEUCHTESCHUTZ VON DEHUNGSMESSTREIFEN]

G. Andrea 10 Apr. 1970 11 p refs Transl. into ENGLISH of a German Report Presented at 4th Intern. Conf. on Exptl. Stress Analysis, Cambridge, England, 6–10 Apr. 1970 Sponsored by AEC
(UCRL-Trans-10492; CONF-700427-1) Avail: NTIS

Strain gauges are sensitive to moisture. Therefore those qualities are examined that are demanded from a technically useful moisture protection which does not inadmissibly disturb the measurement operation of the strain gauge. Theoretical principles of moisture protection are discussed and a formula is established for calculating the protective time. Technical rules for optimal use of a moisture protection are given. A method permitting evaluation of the mechanical influence of strain gauges and protective coating on the measuring object is investigated. Finally, experience with technically optimal application of some moisture protective materials is reported. Author

N71-20401*# Research Triangle Inst., Durham, N.C.

EVALUATION OF A GAS DISCHANGE TRANSDUCER AND ASSOCIATED INSTRUMENTATION NECESSARY FOR THE ASTEROID BELT METEOROID EXPERIMENT

C. D. Parker Feb. 1971 117 p refs
(Contract NAS1-9420)
(NASA-CR-111848) Avail: NTIS CSCL 14B

An electrode assembly located inside a gas filled pressure cell as a pressure transducer was characterized in order to adapt the assembly to a meteoroid experiment for Pioneer F/G. Numerous pressurizing gases were investigated, and a mixture of 75 percent argon and 25 percent nitrogen was selected as suitable for the meteoroid experiment. Additionally, it was necessary to add an initial ionization source to the pressure transducers to achieve reliability and Ni-63 was electroplated on the transducer electrodes for this purpose. Experiments were conducted to verify confidence in their reliability. Author

N71-20427* United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.

WATER SEPARATING SYSTEM Patent

William W. Beauregard, inventor (to NASA) Issued 15 Jul. 1969 (Filed 28 Jun. 1966) 5 p Cl. 62-268; Int. Cl. B01d29/00 Sponsored by NASA
(NASA-Case-XMS-13052; US-Patent-3,455,121; US-Patent-Appl-SN-561223) Avail: US Patent Office CSCL 14B

A liquid separating system in which the fluid to be separated is accumulated and then drawn off by a capillary device is described. The capillary device is connected to a storage chamber having a flexible bladder type wall and the bladder also acts as a supply for fluid utilization in the system. The fluid drawn off through the capillary device is both stored and used to pressurize the bladder to provide a pressurized fluid supply, and gas flow through the capillary device is regulated in accordance with the pressure to be maintained on the bladder.
Official Gazette of the U.S. Patent Office

N71-20428* Spectra-Physics, Inc., Mountain View, Calif.

OPTICALLY PUMPED RESONANCE MAGNETOMETER FOR DETERMINING VECTORAL COMPONENTS IN A SPATIAL COORDINATE SYSTEM Patent

Kenneth A. Ruddock and Robert C. Rempel, inventors (to NASA) Issued 6 May 1969 (Filed 8 Apr. 1966) 11 p Cl. 324-.5; Int. Cl. G01r33/08; Int. Cl. G01n27/72 Sponsored by NASA
(NASA-Case-XGS-04879; US-Patent-3,443,208; US-Patent-Appl-SN-541399) Avail: US Patent Office CSCL 14B

A magnetometer system employing a gas pumped by optical energy is described. The gas is excited by both an alternating axial magnetic field having a predetermined frequency and a predetermined large fixed value magnetic field which allows for Larmor precession of the electron spins of the gas atoms. Phase modulation of the optical energy is responsive to changes in the

ambient magnetic field. The system includes high speed switching for sequentially measuring the phase difference between the reference phase of the axial magnetic field and that of the modulated optical energy to indicate the magnitude of a magnetic field.
Official Gazette of the U.S. Patent Office

N71-20428* Hughes Research Labs., Malibu, Calif.
THRUST DYNAMOMETER Patent
Siegfried Hansen, inventor (to NASA) Issued 26 Aug. 1969 (Filed 10 Oct. 1967) 4 p Cl. 73-117.4; Int. Cl. G01l5/12 Sponsored by NASA
(NASA-Case-XLE-05260; US-Patent-3,463,001; US-Patent-Appl-SN-674355) Avail: US Patent Office CSCL 14B

A dynamometer for measuring the thrust of jet and rocket engines is described. The thrust stand has a movable engine mounting platform supported at three points above a fixed platform by legs having pivotal ends. Counterweights are located below the platform and connected through rigid lever arms to the legs. Displacement of the platform along the direction of the thrust axis of the engine provides measurement of the thrust.
Official Gazette of the U.S. Patent Office

N71-20430* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DOSIMETER FOR HIGH LEVELS OF ABSORBED RADIATION Patent
George F. Pezdirtz and Vernon L. Bell, Jr., inventors (to NASA) Issued 17 Jun. 1969 (Filed 8 Dec. 1966) 4 p Cl. 250-83; Int. Cl. G01t1/04
(NASA-Case-XLA-03645; US-Patent-3,450,878; US-Patent-Appl-SN-600266) Avail: US Patent Office CSCL 14B

A dosimeter for measuring unknown radiation dosage in the range of 1 – 1000 megarads is described. The intrinsic viscosity measurement is taken of a solution of the unknown with the unknown radiation. The unknown radiation dosage is then read from a standard radiation curve plotted from known dosage intrinsic viscosity measurements. Official Gazette of the U.S. Patent Office

N71-20438* Whirlpool Corp., St. Joseph, Mich.
FLUID SAMPLE COLLECTOR Patent
David Cohen and Samuel E. Stone, inventors (to NASA) Issued 15 Apr. 1969 (Filed 28 Mar. 1968) 5 p Cl. 73-422; Int. Cl. G01n1/10 Sponsored by NASA
(NASA-Case-XMS-06767-1; US-Patent-3,438,263; US-Patent-Appl-SN-716795) Avail: US Patent Office CSCL 14B

A fluid sample collector with a sampling section and a collection section is described. The collection system contains a plastic sac having a collar with a rubber plug for connection to the sampling section. Fluid from a feed line is coupled to a hollow member within the sampling section. When the fluid sample has been taken, the sampling section is disconnected. The device is used under zero gravity conditions to prevent leakage problems of the fluid sample. Official Gazette of the U.S. Patent Office

N71-20439* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TWO FORCE COMPONENT MEASURING DEVICE Patent
Earl D. Knechtel and William C. Pitts, inventors (to NASA) Issued 4 Feb. 1969 (Filed 19 Aug. 1966) 7 p Cl. 73-142; Int. Cl. G01e5/12
(NASA-Case-XAC-4886-1; US-Patent-3,425,272; US-Patent-Appl-SN-574290) Avail: US Patent Office CSCL 14B

A measuring device which separately measures the two vector components of a test force is described. Two force targets are pivotally balanced about a single axis of rotation. Each target is alternately exposed to the two component test force. One target is deflected by only the first component. The other target is deflected by only the second component. A nulling system coupled to the targets imparts a restoring force when a particular target is deflected. The magnitude of the restoring force is a direct function of the particular force component.
Official Gazette of the U.S. Patent Office

N71-20442* Rocketdyne, Canoga Park, Calif.
HYDROGEN LEAK DETECTION DEVICE Patent
Marjorie A. Rommel and Victor H. Dayan, inventors (to NASA) Issued 14 Oct. 1969 (Filed 8 May 1967) 6 p Cl. 23-254; Int. Cl. G01n31/10 Continuation-in-part of US Patent Appl. SN-593416, Filed 10 Nov. 1966 Sponsored by NASA
(NASA-Case-MFS-11537; US-Patent-3,472,629; US-Patent-Appl-SN-636878) Avail: US Patent Office CSCL 14B

A device for the reliable detection of free hydrogen in ambient environments is described. The device consists of a porous body containing catalytic metal that heats upon contact with gaseous hydrogen, a reaction inhibiting agent, and a sensing means for detecting changes in temperature of the metal-inhibiting agent mixture. Official Gazette of the U.S. Patent Office

N71-20461* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROCESSING FOR PRODUCING A STERILIZED INSTRUMENT Patent
Lawrence C. Montgomery and Frank A. Morelli, inventors (to NASA) Issued 18 Mar. 1969 (Filed 12 Oct. 1966 3 p 117-6; Int. Cl. A61l13/00; Int. Cl. B44d1/36; Int. Cl. B32b15/08 Continuation-in-part of US Patent Appl. SN-440033, filed 15 Mar. 1965 Sponsored by NASA
(NASA-Case-XNP-09763; US-Patent-3,433,662; US-Patent-Appl-SN-600682) Avail: US Patent Office CSCL 14B

A process for producing a sterilized instrument is described. The instrument is surrounded with a thin liquid film of uncurred polymer and ethylene oxide, as the polymer is curred ethylene oxide gas is generated and a solid encapsulating film is formed around the instrument. The process can be applied to sterilizing solid propellants by combining them with ethylene oxide and to encapsulating medical instruments to preserve them in sterile condition for an indefinite period of time. J.M.

N71-20476*# Chrysler Corp., New Orleans, La. Space Div.
ISOLATION CHARACTERISTICS OF SPACE TELESCOPE SUSPENSION SYSTEMS Final Technical Report
Vincent Spear, Norman Ockman, and Roger Keefe 19 Feb. 1971 175 p
(Contract NAS1-9674)
(NASA-CR-111822) Avail: NTIS CSCL 14B

Results of tests performed to compare the isolation effectiveness of several candidate suspension systems for space telescopes are presented. Spring, hysteresis, and magnetic systems were tested. A 250 kg air bearing platform, which simulated the telescope was attached to a hydraulic shaker by means of the test suspension systems. The shaker arm was moved in a straight line in several disturbance modes, including sinusoidal ramp and step functions. The resultant acceleration and displacement of the air bearing were recorded. Sinusoidal frequencies from .01 to 1.0 Hz are used. The effective spring constants range from .175 to 8.76 N/m. Author

N71-20486# Institute for Nuclear Physics Research, Amsterdam (Netherlands).
THE BOL NUCLEAR RESEARCH PROJECT
Sep. 1970 148 p refs Submitted for publication
Avail: NTIS

A multidetector system was built for detailed investigations of nuclear reactions. The equipment is designed to perform kinematically complete coincidence experiments. A survey of the system and its main characteristics is given. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N71-19464*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ADVANCEMENTS IN BEARINGS, SEALS, AND LUBRICANTS

Erwin V. Zaretsky and Lawrence P. Ludwig *In its* Aircraft Propulsion 1971 p 421–463 refs (See N71-19451 09-28)
Avail: NTIS HC$6.00/MF$0.95 CSCL 11A

Advances in airbreathing turbojet engines have dictated that bearing materials and lubricants operate at higher temperatures, higher speeds, and higher loads. The first generation supersonic transport (SST) turbine engine main-shaft bearings will operate at a bearing temperature of 425 deg F and a maximum speed of 1.3 million DN. It is anticipated that more advanced engine designs may require bearings to operate at temperatures between 500 and 550 F and speeds of approximately 2 million DN. Projection of these trends would predict bearing temperatures to 600 F and bearing speeds of 3 to 4 million DN, which would produce higher bearing operating stresses. A summary of the rolling-element bearing and seal state of the art contributions to solving problems encountered in advanced airbreathing turbojet engines is presented.
Author

N71-19484# National Bureau of Standards, Washington, D.C. Office of Weights and Measures.

SPECIFICATIONS AND TOLERANCES FOR REFERENCE STANDARDS AND FIELD STANDARD WEIGHTS AND MEASURES. 2: SPECIFICATIONS AND TOLERANCES FOR FIELD STANDARD MEASURING FLASKS

Blayne C. Keysar Jan. 1971 8 p ref
(NBS-Handbook-105-2) Avail: SOD $0.25 Catalog No. C 13.11:105-2 CSCL 13I

Specifications and tolerances are recommended as minimum requirements for standards used in the field by state and local weights and measures officials in quantity determinations of liquid commodities.
Author

N71-19485* North American Aviation, Inc., Downey, Calif.

HIGH PRESSURE AIR VALVE Patent

Benjamin T. Howland, inventor (to NASA) Issued 3 Jun. 1969 (Filed 27 Dec. 1966) 8 p Cl. 251-31; Int. Cl. F16k3/26, 17/04 Sponsored by NASA
(NASA-Case-MSC-11010; US-Patent-3,447,774;
US-Patent-Appl-SN-605090) Avail: US Patent Office CSCL 13K

A high pressure control valve formed of an elongated hollow body having an inlet at one end and an outlet intermediate the two ends is described. A sliding valve having circumferentially extending, longitudinally spaced seal means is located in the body. A tubular member extending from the inlet port is telescopically and sealingly engaged with one end of the sliding valve. A passageway in the sliding valve extends from the tubular member to the circumferential wall and is either in or out of communication with the outlet port. A mandrel extends from the other end of the body and is telescopically engaged in the other end of the sliding valve. A spring extends between the end of the body and the valve to bias the sliding valve. An operating port extending into the body permits injection of fluid to move the valve from one position to another. The valve may be biased either open or closed.
Official Gazette of the U.S. Patent Office

N71-19488* Hayes International Corp., Birmingham, Ala.

DEVICE FOR PREVENTING HIGH VOLTAGE ARCING IN ELECTRON BEAM WELDING Patent

Karl K. Hanchey, James C. Mahan, and James S. Kubik, inventors (to NASA) Issued 21 Oct. 1969 (Filed 17 May 1967) 5 p Cl. 219-121; Int. Cl. B23k9/00 Sponsored by NASA
(NASA-Case-XMF-08522; US-Patent-3,474,220;
US-Patent-Appl-SN-640447) Avail: US Patent Office CSCL 13H

A device for preventing high voltage arcing in electron beam welding is described. An arc suppressor plate is mounted on an electron gun from which the electron welding beam emits, the welding operation being performed within an evacuated chamber. A metallic tube has the suppressor plate attached to one end and the other end of the tube is attached to the electron gun. The electron welding beam passes from the electron gun, through the metallic tube and through an opening in the suppressor plate before striking the work. The suppressor plate is positioned very close to the work and attracts and collects arc producing plasma rising from the work during welding.
Official Gazette of the U.S. Patent Office

N71-19489* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

EXTENSOMETER Patent

Carrol D. Hooper, inventor (to NASA) Issued 4 Feb. 1969 (Filed 20 Apr. 1967) 6 p Cl. 33-147; Int. Cl. G01b5/30
(NASA-Case-XMF-04680; US-Patent-3,425,131;
US-Patent-Appl-SN-634040) Avail: US Patent Office CSCL 13I

An apparatus for measuring successive increments of strain on an elastomer is described. The apparatus consists of a self releasing specimen grip mounted to a counter-balanced freely hanging calibrated shaft and a second self releasing specimen grip mounted to the calibrated shaft and free to slide. A sensing device which cooperates with the calibrated shaft provides an electrical signal on successive increments of strain.
Official Gazette of the U.S. Patent Office

N71-19569* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

SLOSH ALLEVIATOR Patent

Wallace J. Nelson, inventor (to NASA) Issued 11 Feb. 1969 (Filed 8 Mar. 1967) 6 p Cl. 137-582; Int. Cl. E03c1/18
(NASA-Case-XLA-05749; US-Patent-3,426,791;
US-Patent-Appl-SN-621714) Avail: US Patent Office CSCL 13D

The combination of a liquid container adapted to transport liquid from one site to another and a floating slosh and swirl alleviator carried on the surface of the liquid is described. A retention mechanism maintains and guides the floating slosh alleviator on the liquid surface as the surface moves relative to the top of the tank and minimizes liquid vibration, agitation, slosh, and swirl when shock inducing forces are imparted to the container and as the liquid is drained.
Official Gazette of the U.S. Patent Office

N71-19570* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FOIL SEAL Patent

Lawrence P. Ludwig, inventor (to NASA) Issued 9 Sep. 1969 (Filed 25 Jan. 1968) 6 p Cl. 277-25; Int. Cl. F16j15/32, 15/34 Continuation-in-part of US Patent Appl. SN-545224, Filed 20 Apr. 1966
(NASA-Case-XLE-05130-2; US-Patent-3,466,052;
US-Patent-Appl-SN-700586) Avail: US Patent Office CSCL 13E

A flexible disk mounted on a rotating shaft in close proximity to a plate having a recessed surface forms the seal. The fluid to be sealed flows into the recess, and leakage is prevented by a pumping action resulting from movement of the disk relative to the plate. A centrifugal force caused by rotation of the flexible disk forces the disk toward the plate.
Official Gazette of the U.S. Patent Office

N71-19619# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DRY FRICTION BEARINGS

B. D. Voronkov 27 Oct. 1970 65 p refs Transl. into ENGLISH of the book "Podshipniki Sukhogo Treniya" Mashinostroyeniye Press, 1968 p 82–139

(AD-716512; FTD-HC-23-458-70) Avail: NTIS CSCL 13/9

Contents: Porous metal ceramic bearings; Mineral ceramic bearings; Selfjlubricating pressed wood bearings; Metal materials for special bearings; Operation of rolling surface bearings under dry friction conditions; Rolling surface bearings with solid lubricants; Rolling surface bearings with self lubricating separators; and Some specifics of the design of self-lubricating ball bearings. GRA

N71-19620# Iowa State Univ. of Science and Technology, Ames. Inst. for Atomic Research.

PRODUCTION OF A LINEAR TEMPERATURE RISE IN AN ELECTRICAL FURNACE

Virgil L. Banowetz Nov. 1970 50 p ref

(PB-195731) Avail: NTIS CSCL 13A

A procedure is offered for producing a linear temperature rise in an electrical furnace by a time-dependent power function. This function is a correspondence of power needed in the heating coil (to produce the desired rate of temperature rise) vs time. A computer analyzes the characteristics of the furnace, calculates the function, and tabulates it. By an iteration of the procedure, the deviation of the temperature-time curve from linearity can be decreased from about 15% to less than 1%. Author (GRA)

N71-19632# Royal Aircraft Establishment, Farnborough (England).

THE DEVELOPMENT OF A BEARING SYSTEM FOR THE DE-SPUN ANTENNA OF A SPIN-STABILIZED SATELLITE. PART 2: LABORATORY INVESTIGATIONS AND THE DEVELOPMENT OF SPECIFICATIONS [ENTWICKLUNG EINES LAGERS FUER DIE ENTDRALLTE ANTENNE EINES SPINSTABILISIERTEN SATELLITEN. TEIL 2: LABORVERSUCHE UND ERARBEITUNG VON SPEZIFIKATIONEN]

M. Granzow et al Aug. 1970 45 p refs Transl. into ENGLISH from German Report No. BMWF-FBW-67-34

(RAE-Lib-Trans-1451-Pt-2; BR22675-Pt-2; BMWF-FBW-67-34-Pt-2) Avail: NTIS

The power input, the variation of operating properties, and the consumption of lubricants are the most important criteria determining the applicability of bearings under space conditions. These parameters were determined by endurance tests in vacuum, using an oil vapor-lubricated bearing-system for the mechanically de-spun antenna of a spin-stabilized communication satellite. The forces and moments operating on the bearings during function within the satellite are calculated. Author

N71-19735# Boeing Co., Renton, Wash. Commercial Airplane Div.

A POTENTIAL NEW RIVET MATERIAL

Donald Webster 18 Dec. 1970 12 p

(AD-716677; D6-24764-TN) Avail: NTIS CSCL 13/5

Additions of nickel and niobium were found to improve the ductility of AFC 77 by promoting a stress-induced austenite to martensite transformation. The combination of properties obtained in the modified alloy appear to be suitable for rivet applications. Author (GRA)

N71-19862*# General Electric Co., Binghamton, N.Y. Avionics Controls Dept.

ROLLER GEAR DRIVE DEVELOPMENT Final Report, Oct. 1970–Feb. 1971

R. B. Seminski and G. F. Auclair Feb. 1971 32 p refs

(Contract NAS8-26213) (NASA-CR-103057; ACD-10104) Avail: NTIS CSCL 13I

The design, fabrication, and test of a research model roller-gear drive assembly which consists of a roller-gear transmission driven by an integrally mounted brushless dc motor are reported. The roller-gear drive has demonstrated the basic performance capability of the roller-gear transmission approach. Although only limited testing has been conducted to date, the drive compactness, low weight and high efficiency have been demonstrated. Author

N71-20109# California Univ., Livermore. Lawrence Radiation Lab.

CLOSER TOLERANCES: ECONOMIC SENSE

James B. Bryan 17 Mar. 1970 20 p Presented at the 1970 Gen. Assembly CIRP, Turin, 28 Aug.–6 Sep. 1970 Submitted for publication Sponsored by AEC

(UCRL-72380; CONF-700831-1) Avail: NTIS

The economics of closer tolerances in manufacturing are discussed. Examples show that improvements can be made in the following areas of consumer interest: reduced initial cost, reduced operating cost, increased lifetime, increased reliability, increased performance, reduced undesirable side effects, ease of use, better portability and durability through miniaturization, ease of repair through the use of fewer parts which are interchangeable, and improved appearance. The principle example used in support of this contention is a model airplane engine costing less than $6.00, which routinely holds a tolerance of 50 microinch on the clearance between the piston and cylinder. Author

N71-20125*# United Aircraft Corp., East Hartford, Conn. Research Labs.

INVESTIGATION TO DEVELOP A DIRECT MELT FIBERIZATION PROCESS FOR PRODUCTION OF OXIDE FIBERS Final Report

M. Basche and R. D. Veltri 30 Oct. 1970 66 p refs

(Contract NAS3-13212)

(NASA-CR-72812) Avail: NTIS CSCL 13H

The production of aluminum oxide fibers by a direct melt fiberization process was studied. Molybdenum proved to be a satisfactory material for holding molten aluminum-oxide for short periods of time and a successful crucible and orifice design was developed. Although the program was primarily experimental, a short computer program was run to aid in defining the state of fluid flow through the crucible orifice. The experimental results and the calculations both led to the conclusion that the molten liquid flow through the squirting orifice was laminar in nature and the break-up of the liquid aluminum oxide jet was caused by surface tension forces (i.e. free jet dynamics) and not by turbulence produced within the jet orifice. Only short fibers of aluminum oxide were obtained under this program due to the jet break-up. Attempts to stabilize the stream by cooling or deposition of a solid on the surface of the liquid jet were unsuccessful. The stabilization studies were, however, inconclusive in that optimum positioning of the stabilization and cooling media was not attained due to equipment limitations found later in the program. Author

N71-20227# General Electric Co., Schenectady, N.Y. Research and Development Center.

SIGNATURE ANALYSIS: NON-INTRUSIVE TECHNIQUES FOR INCIPIENT FAILURE IDENTIFICATION APPLICATION TO BEARINGS AND GEARS

B. Weichbrodt and Kempton A. Smith *In* NBS Space Simulation Oct. 1970 p 407–448 refs (See N71-20201 09-11)

Avail: SOD $5.25

Acoustic and vibration signals generated by operating machinery are used to diagnose its internal condition. It is shown how characteristic signatures are electronically extracted from the overall noise and vibration signals. By interpreting these signatures

in the light of engineering knowledge of the machinery under study, it is possible to identify incipient failure modes long before final failure. Specific applications to bearing and gear diagnostics are discussed and it is shown how the diagnostic process is electronically implemented and automated. Author

N71-20333*# General Electric Co., Schenectady, N.Y. Corporate Research and Development.
SPIRAL GROOVE FACE SEAL DEVELOPMENT FOR SNAP 8 Final Report, 31 May 1968 – 7 Aug. 1970
A. J. Orsino, J. A. Findlay, and H. J. Sneck (Rensselaer Polytechnic Inst.) 7 Aug. 1970 65 p refs
(Contract NAS3-11824)
(NASA-CR-72826; S-71-1017) Avail: NTIS CSCL 11A

The design and test of a spiral groove face seal for use on the SNAP-8 alternator as a self-actuated shutdown seal are detailed. The concept is intended to improve system reliability by assuring the presence of lubricant in the bearing cavity at all times. The purpose was to demonstrate that a seal, which was compatible with the SNAP-8 system, could successfully complete a 2500 hour endurance run and 100 start-stops. The seal failed at the beginning of these tests. The cause of this failure was most likely either a foreign particle in the seal, or seal warpage. Bronze and tool steel were among the materials used in the tests. Author

N71-20392*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN STUDY OF SHAFT FACE SEAL WITH SELF-ACTING LIFT AUGMENTATION. 3: MECHANICAL COMPONENTS
Lawrence P. Ludwig and Robert L. Johnson Washington Mar. 1971 19 p refs
(NASA-TN-D-6164; E-5980) Avail: NTIS CSCL 11A

A main shaft face seal with self-acting geometry was designed for gas turbine engine applications. The seal design goal was to minimize thermal deformation; this was achieved, in part, through use of thermal shielding and through use of a molybdenum alloy which has high thermal conductivity and low thermal expansion. Also, the seal seat was structurally isolated from the shaft by a radial spacer which mitigated the thermal movements of the shaft. Further, axial clamping of the seat through a bellows spacer limited the axial clamping force and thus minimized clamping deformation. Wear measurements after 120 hours of operation under simulated engine conditions of a 200-psi (138 N/sq cm) pressure differential, a 400-ft/sec (122-m/sec) sliding speed, and a 1000 F (811 K) sealed gas temperature showed that thermal deformation was not excessive. Author

N71-20393* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
WELD CONTROL SYSTEM USING THERMOCOUPLE WIRE Patent
William M. McCampbell, inventor (to NASA) Issued 29 Jul. 1969 (Filed 7 Dec. 1967) 4 p Cl. 228-9; Int. Cl. B23k9/02, 9/06
(NASA-Case-MFS-06074; US-Patent-3,458,104;
US-Patent-Appl-SN-688743) Avail: US Patent Office CSCL 13H

Control of fusion welding is considered through use of a thermocouple which has a current flow proportional to the heat of the weld at any instantaneous point. The thermocouple circuit is formed by the work plate itself and a wire of dissimilar metal below the work plate and along the seam to be welded. The weld puddle contacting the wire forms the hot thermocouple junction. Official Gazette of the U.S. Patent Office

N71-20394*# General Electric Co., Cincinnati, Ohio.
DESIGN, PERFORMANCE, AND EVALUATION OF SWITCHGEAR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS
A. H. Powell, Lawrence A. Mueller, and Ernest A. Koutnik Washington NASA Mar. 1971 65 p refs
(Contract NAS3-9421)
(NASA-CR-1719; GESP-372) Avail: NTIS CSCL 18I

An ac circuit breaker with a vacuum interrupter for large space power systems has been built and tested in a high-vacuum (0.000001 torr range) and 1000 F (538 C) temperature environment. The ac breaker, rated 1000 volts, 600 amperes, 1000 hertz, met interrupting and load-switching requirements. The breaker was endurance tested at full rated current for 2700 hours. Author

N71-20395* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EVAPORANT SOURCE FOR VAPOR DEPOSITION Patent
George D. Adams, inventor (to NASA) Issued 9 Sep. 1969 (Filed 31 Aug. 1967) 6 p Cl. 219-275; Int. Cl. F22b1/00; Int. Cl. C23c11/00
(NASA-Case-XMF-06065; US-Patent-3,466,424;
US-Patent-Appl-SN-665679) Avail: US Patent Office CSCL 13H

A spatterproof evaporant source for use in vacuum depositing of thin solid films upon a substrate is described. The metallic cartridge for containing evaporable material has a vapor exit opening formed in the central region of the upper side of the cartridge. An inwardly depressed dimple with perforations is formed in a metallic strip beneath the vapor exit opening. Vapors pass through the perforations and are initially deflected by the portion of the upper side of the cartridge around the vapor exit opening and are subsequently re-evaporated or deflected upward through the vapor exit opening to the substrate. Any gross particle spatterings through the perforations are trapped in the dimple cavity or are reflected through the vapor exit opening at such a low trajectory that they do not reach the substrate to damage the film being deposited. Official Gazette of the U.S. Patent Office

N71-20399*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUMERICAL ANALYSIS OF FLOW AND PRESSURE FIELDS IN AN IDEALIZED SPIRAL GROOVED PUMPING SEAL
John Zuk and Harold E. Renkel Washington Mar. 1971 58 p refs
(NASA-TN-D-6183; E-5948) Avail: NTIS CSCL 11A

A computer program is presented for finding the flow and pressure fields in a spiral-grooved pumping seal model for the limiting case of zero clearance. The governing nonlinear partial differential equations are solved numerically using the method of finite differences and over-relaxation. The program is written in FORTRAN 4 and is completely described including the program listing, flow charts, and sample problem. The computer program calculates the net volume flow rate, velocity profiles and pressure distributions for specific axial pressure gradients. Reynolds number, and aspect ratios. Other biharmonic problems may be solved using this program. Author

N71-20440* Electro-Optical Systems, Inc., Pasadena, Calif.
SOIL PARTICLES SEPARATOR, COLLECTOR AND VIEWER Patent
Douglas G. Ritchie, inventor (to NASA) Issued 14 Oct. 1969 (Filed 24 Jan. 1968) 6 p Cl. 209-10; Int. Cl. B04b3/08, 3/00
Sponsored by NASA Prepared for JPL
(NASA-Case-XNP-09770; US-Patent-3,472,372;
US-Patent-Appl-SN-700120) Avail: US Patent Office CSCL 13I

A mechanism for screening a soil sample to obtain particles for television viewing is described. The device would be used on spacecraft engaged in lunar exploration. The mechanism consists of a bin for receiving the soil sample, apparatus for rapidly oscillating the bin about a pivot to create centrifugal forces to push the particles through coarse and fine screens, a plastic sheet for

receiving the particles, and a means for carrying the plastic to a television camera for observation of the particles.
Official Gazette of the U.S. Patent Office

N71-20441* North American Aviation, Inc., Downey, Calif.
LOAD RELIEVING DEVICE Patent
Ernest T. Hillberg, inventor (to NASA) Issued 14 Oct. 1969 (Filed 7 Dec. 1967) 5 p Cl. 73-141; Int. Cl. G01l5/12; Int. Cl. G01g3/14 Sponsored by NASA
(NASA-Case-XMS-08329-1; US-Patent-3,472,069; US-Patent-Appl-SN-688742) Avail: US Patent Office CSCL 13I

A load relieving device for transferring the load from a load cell to a bypass mechanism so as to remove all weight from the load cell between load readings is described. The load cell is provided with a flexible coupling at each end, the upper one connected to the piston shaft of a hydraulic or pneumatic piston and cylinder arrangement. The lower flexible coupling is connected to the load by a load transfer member. Movement of the piston transfers the load from the load cell to the bypass mechanism.
Official Gazette of the U.S Patent Office

N71-20443* North American Aviation, Inc., Canoga Park, Calif.
METHOD OF JOINING ALUMINUM TO STAINLESS STEEL Patent
Douglas B. Nord and Ernest G. Huschke, Jr., inventors (to NASA) Issued 21 Oct. 1969 (Filed 17 May 1967) 5 p Cl. 29-492; Int. Cl. B23k31/02 Sponsored by NASA
(NASA-Case-MFS-07369; US-Patent-3,473,216; US-Patent-Appl-SN-640462) Avail: US Patent Office CSCL 13H

A method is described for joining an aluminum component to a stainless steel component. A thin coating of titanium or titanium alloy is metallurgically bonded to the solvent degreased surface of a stainless steel component. An aluminum or aluminum alloy coating is then bonded onto the titanium coating which permits the brazing or welding of the aluminum coating to the aluminum component. A strong and ductile metallurgical bond is thus formed which meets the severe service requirements for rocket engine applications. No degradation of metallurgical structure or properties occur after extended exposure to thermal cycling and severe vibrational stresses.
J.M.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N71-19443# California Inst. of Tech., Pasadena. Dept. of Electrical Engineering.
RESEARCH IN NONLINEAR OPTICS Interim Progress Report, 1 May 1969 – 30 Apr. 1970
Amnon Yariv 16 Oct. 1970 18 p refs
(Grant AF-AFOSR-1774-69)
(AD-716540; AFOSR-70-2725TR) Avail: NTIS CSCL 20/5

The report is on elucidating the properties of ultrashort pulses emitted by mode-locked neodymium and ruby lasers. The point of departure is to measure properties of individual ultrashort pulses rather than as an average of many pulses. An experimental approach to obtain the pulse width and energy is outlined including approximate results. More accurate measurements is awaiting more accurate computer solutions of associated partial differential equations. As a side, these experiments lend themselves to complementary studies of the chemical dynamics of Q-switch dyes such as the decay times on a time scale comparable to ultrashort pulse durations.
Author (GRA)

N71-19450# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
REFLECTION TRANSMISSION FULL-VIEW HOLOGRAMS
Nicholas George Jul. 1970 8 p refs Presented at the Intern. Symp. on the Appl. of Holography, Besancon, France, 6 – 11 Jul. 1970
(Contract AF-AFOSR-1492-68)
(AD-716571; AFOSR-70-2626TR) Avail: NTIS CSCL 14/5

A planar hologram is described on which is recorded the complete wavefront emanating from an object space. If the illumination is monochromatic, first, two separate holograms are made for later transfer to a more centrally-positioned plane. With incoherent illumination of a large object, then two holographic stereograms are made as the intermediary for later transfer. These full-view holograms are classified into the following types: (1) reflection-transmission, (2) transmission-transmission, and (3) reflection-reflection. It is shown that the full-view reconstruction is approximately what would be expected from the linear superposition of the outputs of the basic transmission and reflection holograms.
Author (GRA)

N71-19518 Rensselaer Polytechnic Inst., Troy, N.Y.
FACTORS INFLUENCING THE GAIN IN NEODYMIUM DOPED LASER GLASS
David Kenneth Duston (Ph.D. Thesis) 1969 163 p
Avail: Univ. Microfilms: HC $7.60/Microfilm $3.00 Order No. 70-2615

Quantitative measurements of the terminal level lifetime and energy transfer rate in Nd-doped laser glass were produced. An experimental technique was used for these measurements which involved a low intensity probe beam and a high intensity Q-switched perturbing beam intersecting in an optically pumped Nd glass laser amplifier. The experimental results on the terminal level lifetime measurements agree with the results obtained from a digital computer simulation of the amplification process. The energy transfer times measured varied from 2.5 to 13 nanoseconds. The transfer time decreased with increasing temperature; the results are accurate to within a factor of two.
Dissert. Abstr.

N71-19552# Perkin-Elmer Corp., Wilton, Conn.
TRACK FORMATION IN OPTICAL GLASS CAUSED BY ELECTROSTRICTIVE LASER BEAM SELF-FOCUSING
Edwin L. Kerr (Ph.D. Thesis) Oct. 1970 140 p refs
(Contract F19628-69-C-0220)
(AD-715937; PE-9878; Scientific-1; AFCRL-70-0599) Avail: NTIS CSCL 20/5

An electrostriction mechanism for laser beam self-focusing and track formation in transparent optical glass is analyzed theoretically. Electrostrictive self-focusing occurs when a laser pulse of sufficiently high power and rapid rise time passes through a transparent medium. During self-focusing, the beam collapses to a small radius, leaving a track of permanent damage. Typical tracks have a diameter of a few wavelengths of light and extend up to several centimeters. The propagation of the beam is described by a new small-scale beam tracing equation, derived from Maxwells equations. The equation includes the effect of the inhomogeneous index term of the vector light wave equation as well as beam diffractive. For steady-state Kerr and electrostrictive trapping, the new equation gives experimentally correct filament diameters. A trapping threshold is derived for three pulse shapes, covering the steady-state, transitional, and transient regimes of pulse duration and beam size. A formula for computing the power to achieve a given maximum intensity is derived. A computer movie of beam trapping shows the collapse of the beam during self-focusing.
Author (GRA)

N71-19573# Air Force Cambridge Research Labs., Bedford, Mass.
OPTICAL PROPERTIES OF RARE EARTH DOPED

GERMANATE GLASSES
Herbert G. Lipson 23 Oct. 1970 75 p refs *Its* Phys. Sci. Res. Papers No. 404
(AD-716386; AFCRL-70-0612) Avail: NTIS CSCL 7/4

Absorption spectra were used to determine the effect of modifier ions on the splitting and relative intensity of neodymium spectral terms in germanate and other glasses. The behavior of spectral components is related to the degree of inhomogeneous broadening and changes in the site symmetry of the neodymium ion. A similarity between the wavelength position of neodymium term levels and their total width in glasses and crystalline neodymium oxide has been observed. Fluorescence spectra for neodymium, erbium, and holmium ions in sodium germanate glass are reported and the absorption lines involved in excitation with both lamp and laser sources discussed. The lines of an argon-ion laser are found to be more convenient and powerful sources for the excitation of rare earth ion fluorescence than mercury vapor or tungsten lamp sources. The energy level diagram of neodymium in sodium germanate glass was determined from absorption and fluorescence peak spectra. A relationship between the strength of infrared absorption bands involved in cross-relaxation processes and the extent of neodymium fluorescence quenching was observed. Fluorescence conversion efficiencies comparable or higher than those of commercial laser glasses are found for neodymium in sodium germanate glass by both laser and lamp excitation methods. Germanate glasses show good potential as laser hosts for a number of rare earth ions. Author (GRA)

N71-19621# California Univ., Berkeley. Dept. of Chemistry.
ULTRARAPID-SCAN INFRARED SPECTROSCOPIC STUDY OF EXTREMELY REACTIVE MOLECULES AND OF INFRARED LASERS Final Report, 1 Feb. 1968 – 31 Jan. 1970
George C. Pimentel Oct. 1970 13 p refs
(Grant AF-AFOSR-1536-68)
(AD-716004; AFOSR-70-2535TR) Avail: NTIS CSCL 7/4

Instrument modifications have made it possible to scan a 100/cm spectral region in 100 microseconds with 1/cm spectral resolution and with sample path lengths extending to 50 meters. Thus detection of transient free radicals, produced through flash photolysis, is now possible. The free radicals CF3, CCl3, and CH3 have been detected, all in the gas phase, using infrared spectroscopy, for the first time. The kinetics of the CF3 + CF3 to C2F6 reaction have been studied and a small activation energy is revealed. Five types of chemical reactions have been shown to give infrared laser emission with thirty-two different examples. The types are: Three body reactions; Abstraction reactions; Elimination reactions; Photoelimination reactions; and Photodissociation reactions. By examining the relative gain of the various rotation-vibration transitions, the rate constant ratio can be measured, k(v)/k(v-1). Through the principle of microscopic reversibility, these ratios are clarifying the role of vibrational degrees of freedom in chemical reaction rates. Author (GRA)

N71-19633*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANALYSIS OF OPTICAL COMPONENT MOVEMENT BY HOLOGRAPHIC INTERFEROMETRY
John R. Williams and B. Nelson Norden Washington Mar. 1971 38 p refs
(NASA-TM-X-2227; M-437) Avail: NTIS CSCL 20E

The application of holographic interferometry to mirror movement was investigated for orbiting of a large (approximately three meter) telescope, since numerous parameters such as mount sag, mirror surface creep, etc., manifest themselves in the form of displacements. Both theoretical and experimental data are presented for simple mirror rotation with a theoretical extension to include three-dimensional translation. Author

N71-19651# Georgetown Univ., Washington, D.C. Dept. of Physics.
DESIGN AND CONSTRUCTION OF A FLASH PHOTOLYSIS SYSTEM FOR LASER STUDIES
C. L. Currie and T. L. Burks 22 May 1970 41 p refs
(Contract F44620-68-C-0017; Proj. Themis)
(AD-716000; AFOSR-70-1503TR) Avail: NTIS CSCL 14/2

A flash photolysis apparatus has been designed and constructed. A maximum versatility in experimental arrangements has been incorporated within its design and initial special experiments and actinometry confirm expected results. The hydrofluoric acid-carbon dioxide gas-phase laser system has been chosen as the object of an intensive study of gas laser energy transfer mechanisms. Since the vibrationally and rotationally excited hydrofluoric acid molecule HF^* can be produced photochemically by a variety of photoelimination processes and since hydrofluoric acid has a well resolved vibration-rotation spectrum (due to its small moment of inertia, I, and large rotational constant B), the hydrofluoric acid and carbon dioxide $HF^* + CO_2$ gas-phase laser system appears to be an excellent candidate for further examination by flash photolysis of energy transfer mechanisms in gas lasers. Author (GRA)

N71-19736# Naval Intelligence Command, Alexandria, Va. Translation Div.
GENERATION OF RADIATION IN THE 2.8 MICRON m RANGE BY VIBRATIONAL ROTATIONAL TRANSITION IN THE HF MOLECULE [GENERATSIYA IZLUCHENIYA V OBLASTI 2,8 mkm NA KOLEBATELNOVRASHCHATELNYKH PEREKHODAKH MOLEKULY HF]
G. G. Dolgov-Savelyev et al 4 Jan. 1971 11 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 58, no. 4, 1970 p 1197–1203
(AD-716680; NIC-Trans-3152) Avail: NTIS CSCL 20/5

Generation in MoF6 + H2, UF6 + H2, and F2 + H2 mixtures at pressures up to 120 mm Hg was investigated. It is shown that generation duration is considerably longer in an F2 + H2 mixture when the illumination pulse lasts for 10 micro sec. The paper deals with the investigation of generation in the HF molecule obtained by the pulse photolysis of the fluorine compounds MoF6, UF6, F2 in an H2 mixture. Author (GRA)

N71-19797*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
APOLLO 14 LASER RANGING RETRO-REFLECTOR EXPERIMENT: DESIGN CERTIFICATION REVIEW REPORT
15 Sep. 1970 33 p
(Contract NAS9-5829)
(NASA-CR-114900; BSR-3009) Avail: NTIS CSCL 20E

Detailed documentation of the design certification of the Apollo 14 Laser Ranging Retroreflector (LRRR) experiment is presented. The information illustrates the design maturity of the LRRR and its suitability for use in manned space flight. A brief review is given of the Apollo Lunar Surface Experiments Package (ALSEP) Program background, the Early Apollo Scientific Experiments Package (EASEP) experiment, and the LRRR design objectives. Following a description of the performance required of the LRRR during the Apollo 14 mission and lunar surface operation, the program of testing this performance is outlined. The results of the Apollo 14 LRRR test program are summarized to show that the LRRR designed for this lunar surface experiment meets the specified requirements. Reference is also made to testing previously conducted on the EASEP LRRR Experiment. Author

N71-19822# California Univ., Irvine. School of Engineering.
INFRARED ISOLATOR USING YTTRIUM IRON GARNET
Hideya Gamo and Shih-Shung Chuang 30 Jun. 1970 113 p refs
(Grant AF-AFOSR-1666-69)
(AD-716468; AFOSR-70-1956TR) Avail: NTIS CSCL 20/5

Infrared isolators using the Faraday rotation in a single crystal Yttrium Iron Garnet (YIG) and calcite dichroic polarizers have been built. By using the YIG crystal with thorium fluoride antireflection coating the authors obtained isolation better than 32 dB and the insertion loss smaller than 1.8 Db and 1.3 dB at He-Xe 3.5 micron and He-Ne 3.39 micron gas laser lines, respectively. The basic principles of isolators, theory of magneto-optical effect, and Faraday effect in various magnetic materials are surveyed. The optical and magnetic properties of single crystal YIG are examined. The design and performance of infrared isolaters using 45-degree Faraday rotation in a single crystal YIG (6mm long, 3mm diameter) with a small permanent magnet and calcite dichroic polarizers is described. The isolation of the YIG isolator is practically limited by the induced ellipticity due to internal multiple reflections, boundary effect, and magnetic birefringence produced in YIG. Improvement of isolation due to the antireflection coating is discussed. A few representative applications of YIG isolator to unilateral laser amplifiers systems to decoupling a laser from a Fabry-Perot interferometer and also to the ring laser gyroscope are described. Author (GRA)

N71-19948# American Science and Engineering, Inc., Cambridge, Mass.

DEVELOPMENT OF METHODS FOR PREPARING ZONE MELTING FEED RODS Final Report, 1 Oct. 1968 – 1 Aug. 1970

Carolus M. Cobb and Elbridge B. Wallis 30 Oct. 1970 67 p refs

(Contract F19628-69-C-0061)

(AD-716421; ASE-2552; AFCRL-70-0608) Avail: NTIS CSCL 13/8

A study has been made of the process technology required for the production of zone melting feed rods of pure oxides. A method of preparing high density aluminum oxide feed rods without the use of binding agents has been developed. These rods meet the requirements of dimensional tolerances, strength, dopant concentration and purity which are essential for the zone melting based on focussed high intensity light sources. Results of the program indicate that the process is capable of producing ultra-high purity rods suitable for basic studies of laser degradation. Author (GRA)

N71-20400* Korad Corp., New York.

LASER APPARATUS FOR REMOVING MATERIAL FROM ROTATING OBJECTS Patent

Harvey Popick and Donald L. Roberts, inventors (to NASA) Issued 14 Oct. 1969 (Filed 3 Apr. 1967) 4 p Cl. 219-121; Int. Cl. B23k9/04 Sponsored by NASA Prepared in cooperation with Union Carbide Corp., New York

(NASA-Case-MFS-11279; US-Patent-3,472,998; US-Patent-Appl-SN-628094) Avail: US Patent Office CSCL 20E

An apparatus for removing material from a rotating object to effect dynamic balancing is described. A laser is employed to remove the material by timing the firing of the laser to correspond to a that position of the rotating object where the material is to be removed. The laser pumping circuits are also described. The device is considered to be useful with very high speed rotating objects where precise removal of material is required. F.O.S.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N71-19352 Rensselaer Polytechnic Inst., Troy, N.Y.

ELECTROMIGRATION AND VOID KINETICS IN SILVER

Hanumant R. Patil (Ph.D. Thesis) 1969 142 p

Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 70-2636

Electromigration in both oxygen-free high purity silver (99.999%) and oxygen-bearing lower purity silver (99.99% and 99.9%) has been measured using the vacancy flux method. The method consists of measuring longitudinal and transverse dimensional changes along the length of a hot thin-walled hollow cylindrical sample placed in a protective argon ambient. The samples are heated by means of a large DC current and the ends are water cooled. This procedure results in a parabolic temperature distribution with the maximum at the sample center. As a result of improved temperature determination, the effective charge is found to be about −6.5e in contrast to the earlier value of −25e, bringing the value of the defect resistivity for silver in agreement with those for other noble metals. Void formation on the cathode side and consequent sample elongation were observed only in the less pure silver and could not be induced in the purer material even when charged individually with oxygen or hydrogen. Dissert. Abstr.

N71-19441# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.

DIRECT STUDIES OF FRACTURE MECHANISMS IN METALS AT HIGHEST MAGNIFICATIONS

Robert W. Bauer, Robert L. Lyles, Jr., and Heinz G. F. Wilsdorf Dec. 1970 35 p refs

(Contract N00014-69-A-0060-0004)

(AD-716573; MS-3533-105-70U; TR-1) Avail: NTIS CSCL 11/6

Thin silver single crystals and polycrystalline foils of type 304 stainless steel in both the solution treated and sensitized condition were strained to fracture inside a high voltage electron microscope. The specimens ranged in thickness from 0.5 to 2 microns. The design of a micro straining tensile device and techniques of specimen preparation are discussed. Results indicate that bulk fracture mechanisms are operative in these materials. Necking, shearing, formation and coalescence of holes, thinning ahead of propagating crack, and the dislocation structure in plastic zone preceding the crack are presented and discussed. Author (GRA)

N71-19446# Tuskegee Inst., Ala. School of Engineering.

DENSITY DETERMINATIONS USING A GAMMA RADIATION ATTENUATION TECHNIQUE Annual Progress Report

I. G. Dillon 30 Sep. 1970 31 p refs

(Contract AT(40-1)-3604)

(ORO-3604-6; APR-4) Avail: NTIS

The development of a gage for measuring the density of alkali metal vapor or liquid is described. A 2150 C cesium-137 gamma source and a thallium-activated sodium iodide scintillation detector with a 400 channel analyzer are used. NSA

N71-19615# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.

BEHAVIOR OF SILICA INCLUSIONS DURING SOLIDIFICATION OF AN IRON BASE ALLOY Final Report, Jan. 1969 – Jan. 1970

M. Myers and M. C. Flemings Sep. 1970 190 p

(Contract DAAG46-68-C-0044)

(AD-715940; AMMRC-CR-69-14(F)) Avail: NTIS CSCL 11/6

Results are presented of an experimental program designed to study the behavior of inclusions during dendrite growth and the nature of the interactions between the inclusions and the dendrites. The base alloy employed was Fe-50% Cu, chosen because of its very wide freezing range (336C). One series of experiments involved isothermal holding of a previously solidified alloy at a temperature

within the liquid plus solid region. The alloy contained approximately .25 volume percent silica inclusions. A series of continuous cooling (continuous solidification) experiments were conducted at cooling rates from 19C/sec to .3C sec. Decreasing cooling rate (increasing local solidification time) altered inclusions in qualitatively the same way as did increased isothermal holding time. GRA

N71-19634# Syracuse Univ. Research Corp., N.Y. Materials Science Lab.

IMPROVEMENT IN CRACK DETECTION BY ULTRASONIC PULSE-ECHO WITH LOW FREQUENCY EXCITATION Final Report, 28 Oct. 1969 – 27 Oct. 1970

John G. Sessler and Volker Weiss Oct. 1970 47 p refs
(Contract N00140-70-C-0223; ARPA Order 1243)
(AD-716642) Avail: NTIS CSCL 14/2

The results of studies to determine the feasibility of inducing stress in metal samples with low frequency excitation have indicated that the effective use of this technique is limited to excitation in the cyclic frequency range of 1000 Hz and below. Best results were obtained with solid coupling of low frequency exciters to test material. Attempts to induce stress with excitation at 20 kHz were not very successful with the techniques and equipment used in these studies. Author (GRA)

N71-19654 Rensselaer Polytechnic Inst., Troy, N.Y.

A CALCULATION OF INTEGRATED X-RAY INTENSITIES FOR ZINC

David Douglas Moyle (Ph.D. Thesis) 1969 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 70-2633

Analytical expressions for the differential cross sections for the scattering of X-ray photons from a general crystal have been developed. Numerical integration of these expressions over volumes in reciprocal space corresponding to the two types of scan used in integrated intensity measurements has been carried out for zinc. The phonon frequencies and eigenvectors which enter into these expressions are evaluated using two force models: the modified axially symmetric model and the tensor model. Acoustic and optic mode contributions are compared for several reflections and the behavior of the thermal diffuse scattering near a systematic absence is shown. Dissert. Abstr.

N71-19689# WADCO Corp., Richland, Wash.

NOTE ON THE INTERDEPENDENCY OF SWELLING, VOID DIAMETER AND VOID NUMBER DENSITY IN ANNEALED AISI TYPE 304 STAINLESS STEEL

J. L. Straalsund and J. F. Bates Oct. 1970 17 p refs
(Contract AT(45-1)-2170)
(WHAN-FR-15) Avail: NTIS

A set of three mutually consistent empirical equations were developed to describe void number density, void diameter, and swelling (or void volume) as a function of fluence and temperature. The equation for swelling reflects trends consistent with available transmission electron microscopy data. Author (NSA)

N71-19700*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

HOT CORROSION OF TD NICKEL CHROMIUM IN A HIGH VELOCITY GAS STREAM

W. A. Sanders and H. B. Proust [1971] 22 p refs Proposed for presentation at the 10th Natl. Conf. on Environ. Effects of Aircraft and Propulsion Systems, Trenton, 18 – 20 May 1971; Sponsored by Navy Dept.
(NASA-TM-X-52976; E-6183) Avail: NTIS CSCL 11F

TD Nickel (2 percent Thoria-dispersed nickel) and TD Nickel Chromium (2 percent Thoria-dispersed Nickel-20 percent Chromium alloy) 1.5 mm sheet specimens were cyclically tested for susceptibility to hot corrosion in a Mach 0.5 gas stream of Jet A-1 fuel combustion products containing 2 ppm sea salt. Tests as long as 500 one-hour cycles between room temperature and specimen hot zone temperatures of 899 C, 982 C, and 1149 C were performed. Evidence of hot corrosion was found for both materials in the 899 C and 982 C tests, but not at 1149 C. It was concluded that because of high metal thickness losses neither alloy in sheet form is suitable for long time engine application in a hot corrosion environment at temperatures of 982 C or above. Author

N71-19711# Technion-Israel Inst. of Tech., Haifa. Dept. of Materials Engineering.

A MECHANICS APPROACH TO PROJECTILE PENETRATION

Jonathan Awerbuch May 1970 37 p refs
(Contract F61052-69-C-0042)
(AD-716001; MED-28; AFOSR-70-2588TR; SR-6) Avail: NTIS CSCL 19/4

In the program reported in the paper, a mathematical model was developed which describes the mechanism of the normal penetration of metallic targets. The model considers all the forces acting on the projectile during penetration, bearing in mind that it is deformed during the penetration and that its effective mass increases during penetration due to the concomitant motion of part of the target mass. With the aid of the mathematical expressions the projectiles velocity after perforation can be calculated by substituting the information on the cavity diameter obtained experimentally. Another part of this program consisted of a series of penetration experiments. The experimental results for the velocity drop due to normal perforation of metallic plates were compared with the mathematical model. Author (GRA)

N71-19712# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CERTAIN CHARACTERISTICS OF STRESS RELAXATION IN REFRACTORY ALLOYS UNDER VIBRATION CONDITIONS

D. Ya. Bragin et al 12 Oct. 1970 12 p refs Transl. into ENGLISH from Proceedings of 5th, Termopechnost Materialov i Konstruktiv Nykh Elementov (Kiev), 1969 p 5 – 55
(AD-716520; FTD-MT-24-228-70) Avail: NTIS CSCL 11/6

Experimental investigation of the plastic deformation of EI481 steel, Armco iron, and the EI437B, EI617, and EI598 alloys during stress relaxation tests in the presence of vibrations. It is shown that certain conditions, where aging is accelerated by vibrations (accompanied by a reduction in volume), the material exhibits an enhanced relaxation stability. Author (GRA)

N71-19734 Connecticut Univ., Storrs.

THE THERMAL AND ELECTRICAL CONDUCTIVITIES OF GOLD IRON ALLOYS AT LOW TEMPERATURES

Paul Louis Garbarino (Ph.D. Thesis) 1969 187 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 70-1260

Measurements were made of the thermal and electrical conductivities of a specimen of pure gold and twelve dilute gold-iron alloys ranging in iron concentration from 0.01 to 1 at. % over the temperature range 1 to 4.2 K. In addition the electrical conductivities of six other gold-iron alloys ranging in iron concentration from 0.05 to 2 at. % were measured over the same temperature range. The Lorenz ratios of the more concentrated alloys are found to decrease slowly with decreasing temperature due to the onset of small angle inelastic conduction electron scattering. At the upper end of the concentration range the Lorenz ratio is, to within the experimental uncertainty contributed by the large fractional magnitude of the lattice thermal conductivity, temperature independent but depressed by about 15% relative to the theoretical Lorenz number. Dissert. Abstr.

N71-19799# Ohio State Univ. Research Foundation, Columbus.
A STUDY OF STRESS CORROSION CRACKING IN THE IRON NICKEL CHROMIUM ALLOY SYSTEM IN CHLORIDE ENVIRONMENTS Quarterly Report, 1 Sep. – 30 Nov. 1969
R. W. Staehle 23 Jun. 1970 44 p refs
(Contract AT(11-1)-2069)
(COO-2069-5) Avail: NTIS

Results of circulating autoclave tests are reported along with those from transient dissolution studies, and experiments define the effects of nitrogen addition on the stress corrosion cracking behavior. Circulating autoclave studies were conducted at 200 C in 10 ppM Cl(−) + 10 ppM 02. Specimens failed both by localized pitting depending on the alloy composition. A review of the literature on the subject of transient dissolution is included. The applicability to the present state of the art is evaluated. Nitrogen additions are shown to promote the formation of protective film. Author (NSA)

N71-19815*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OBSERVATIONS ON THE CYCLIC AND ISOTHERMAL OXIDATION OF WI-52 AND IN-100
Daniel L. Deadmore Washington Mar. 1971 26 p refs
(NASA-TM-X-2195; E-5994) Avail: NTIS CSCL 11F

Alloys WI-52 and IN-100 were oxidized isothermally and cyclically at 1900 and 2000 F in static furnace air. Exposure cycles of 1, 2, 5, 20, and 170 hr for total oxidation times of up to 340 hr were used. Weight and thickness change measurements were used to evaluate the oxidation behavior. Spalled scale compositions were determined for WI-52. Both alloys spall in cyclic oxidation and are sensitive to cycle frequency. Alloy WI-52 spalls much more and exhibits much greater metal consumption with increased cycle frequency than does IN-100. Author

N71-19816*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECT OF HYPERVELOCITY PROJECTILE MATERIAL ON THE ULTIMATE REFLECTANCE OF BOMBARDED POLISHED METALS
M. J. Mirtich and H. Mark [1971] 10 p refs Presented at the Spring Meeting of the Opt. Soc. of Am., Tucson, Ariz., 5–8 Apr. 1971
(NASA-TM-X-52981; E-6199) Avail: NTIS CSCL 11F

A 76 mm shock tube was used to expose quantitatively various polished metals to hypervelocity impact by micrometer-size projectiles of different compositions, including meteorite material. Spectral reflectance measurements (0.33 to 15.5 mu M) were made on the exposed samples using an integrating sphere and a heated black body cavity. The samples were exposed to the projectiles until additional exposure produced no further change in reflectance. In this manner, the effect of the projectile and the projectile-target combination on ultimate reflectance was found. The differences in ultimate reflectance for different materials indicated the importance of proper selection of projectile material for simulating optical degradation of surfaces by micrometeors. The results of this study indicated that stoney type projectiles rather than metallic should be used in ground studies to simulate the effects of micrometeoroids on the optical properties of polished metals. Author

N71-19850# Mound Lab., Miamisburg, Ohio.
COMPATIBILITY OF Pu(238)O2 WITH VARIOUS REFRACTORY METALS AND ALLOYS Interim Report
J. E. Selle, J. J. English, P. E. Teaney, and J. R. McDougal 23 Oct. 1970 214 p refs
(Contract AT(33-1)-Gen-53)
(MLM-1706) Avail: NTIS

Data accumulated on the compatibility of production grade Pu(238)O2 with various refractory metals and alloys are discussed. The materials discussed are tantalum, tantalum-10 wt % tungsten, T-111, T-222, niobium, molybdenum, TZM, molybdenum-50 wt % rhenium, rhenium, tungsten, tungsten-26 wt % rhenium, hafnium, and zirconium. Test temperatures ranged from 1000 to 2500 C for time periods up to 532 days at the lower temperatures and up to 2000 hr at the higher temperatures. Author (NSA)

N71-19871# Ballistic Research Labs., Aberdeen Proving Ground, Md. Terminal Ballistics Lab.
ELECTRICAL RESISTANCE MEASUREMENTS OF SHOCK COMPRESSED ALUMINUM
Robert E. Franz Nov. 1970 27 p refs
(AD-716328; BRL-MR-2073) Avail: NTIS CSCL 11/6

Electrical resistance changes in aluminum have been measured during shock compression and compared with theoretical values calculated from equation of state data. The measured changes in resistance are larger than changes predicted by the calculations which only take account of the effects of lattice compression and shock temperature. This difference is thought to be due to shock-induced lattice defects, especially dislocations, which were not considered theoretically. Author (GRA)

N71-19907# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
BIBLIOGRAPHY ON ALLOYS QUENCHED FROM THE LIQUID STATE
Pol Duwez Dec. 1970 13 p refs
(Contract AT(04-3)-822)
(CALT-822-17) Avail: NTIS

A technique was developed in 1959 for quenching liquid alloys at very high cooling rates. A bibliography of 163 references from 1960 to 1970 is presented on this technique. NSA

N71-19925# Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu.
MECHANICAL PROPERTIES OF URANIUM AND ITS ALLOYS BETWEEN – 200 C AND 730 C
I. Saxl, J. Otruba, and J. Kocik 1970 91 p refs In CZECHOSLOVAKIAN
(UJV-2436-M) Avail: AEC Depository Libraries

The tensile properties of polycrystalline reactor-grade and adjusted alpha-uranium have been investigated at −200 to 730 C. The temperature dependences of yield stress, ultimate tensile strength, fracture stress, total and homogeneous elongations, and reduction of area are given. A formal analysis of true stress, true strain diagrams and their temperature dependences is carried out. A more detailed study of high temperature deformations in reactor-grade uranium is made on the basis of strain rate cycling experiments. The mechanical tests are supplemented by optical metallographic examination of deformed specimens including the observation of deformed grain structure and observation of crack response and void morphology. Preliminary results concerning deformation processes of beta-uranium are included. Author (NSA)

N71-19987# California Univ., Los Angeles.
PREDICTION OF VARIATION IN FRACTURE TOUGHNESS K SUB Ic FROM SMALL SPECIMEN TESTS
Alan S. Tetelman, Richard A. Wullaert (Effects Technol., Inc.), and Donald Ireland (Battelle Mem. Inst.) 1970 31 p refs Prepared for presentation at the meeting on Pract. Appl. of Fracture Mech. to Pressure Vessel Technol., London, 3–5 May 1971
(Contract DAHC04-69-C-0008)
(AD-716599; TR-4; AROD-8016.4-MC) Avail: NTIS CSCL 11/6

The Charpy transition temperature and low temperature fracture toughness of low alloy steels depend on three parameters; the microcleavage strength, the yield strength, and the critical

crack tip radius. Microcleavage strength and critical crack tip radius appear to be essentially independent of temperature in low alloy steels. A method was developed for relating the change in transition temperature to the change in Charpy transition temperature, since both of these macroscopic measures of toughness depend on the same microscopic parameters. The method for making these calculations and predictions is described. Author (GRA)

N71-20012# North Carolina Univ., Chapel Hill.
[PROPERTIES OF METALS AND ALLOYS] Progress Report, 1 Dec. 1969 – 1 Dec. 1970
1 Dec. 1970 36 p refs
(Contract AT(40-1)-3897)
(ORO-3897-2) Avail: NTIS

Mossbauer studies of recoilless fractions, isomer shifts, and magnetic properties of gold and gold alloys are discussed as well as high pressure studies of the Kondo effect in Cu-Fe alloys. The effect of applied pressure on the lattice resistivity is expressed mathematically with the use of Matthiessen's rule. Bent crystal spectrometer X-ray chemical shift measurements and the calculation of atomic wave functions are also covered. J.M.

N71-20021# Japan Atomic Energy Research Inst., Tokyo.
PLASTIC DEFORMATION OF ZONE-REFINED TUNGSTEN BETWEEN 4.2 AND 300 K
Tatsuo Oku and J. M. Galligan (Brookhaven Natl. Lab.) Aug. 1970 17 p refs Presented at the 2d Intern. Conf. on the Strength of Metals and Alloys, Asilomar, Calif., 30 Aug.–4 Sep. 1970 Sponsored in part by AEC
(JAERI-Memo-4124; CONF-700819-8) Avail: AEC Depository Libraries

The macroscopic deformation behavior of tungsten crystals of various purities was studied. These studies show that a fair portion, approximately 30%, of the temperature dependence of the critical resolved shear stress is impurity dependent. For the crystals used, with resistivity ratios between approximately 2000 and 20,000 increasing purification not only decreased the temperature dependence of the critical resolved shear stress, (C.R.S.S.), but decreased the C.R.S.S. at 4 K, contrary to common assertions. The influence of various types and concentrations of defects, introduced by neutron irradiation, upon the temperature dependence of the C.R.S.S. was also investigated. Author (NSA)

N71-20082*# Scientific Translation Service, Santa Barbara, Calif.
CORROSION RESISTANCE OF ALUMINUM SILICON ALLOYS [KORROZIONNAIA STOIKOST ALUMINIEVO-KREMNIEVYKH SPLAVOV]
D. F. Chernega et al Washington NASA Mar. 1971 12 p refs Transl. into ENGLISH from Fiz.-Khim. Mekh. Mater. (Ukrainian SSR), v. 6, no. 4, 1970 p 53–57
(Contract NASw-2035)
(NASA-TT-F-13506) Avail: NTIS CSCL 11F

The corrosion resistance of Al9 and Al2 alloys was studied in a humid atmosphere and in acid media as a function of the refining process. The corrosion resistance was studied in relation to the hydrogen content introduced by refining with: (1) hexachloro-ethane, (2) universal flux, and (3) dc electrolysis. It is found that the behavior of these alloys with respect to corrosion resistance is related to their hydrogen content. Author

N71-20085# California Univ., Berkeley. Lawrence Radiation Lab.
STRESS CORROSION CRACKING OF A TRIP STEEL
Jean-Pierre Birat (Ph.D. Thesis) Sep. 1970 68 p refs
(Contract W-7405-eng-48)
(UCRL-20300) Avail: NTIS

Tensile, toughness, and fatigue tests were conducted on a 0.27 C, 8 Ni, 12 Cr metastable austenitic steel to test the effect of strainrate and environment. Increasing the strain-rate was found to increase the yield strength and the crack growth rate in fatigue, decrease the elongation and the tensile strength, and allow a crack to become unstable in a constant strain rate toughness test. The effect of distilled water was found to bring down the toughness instability to strain-rates one-thousand times smaller than in air tests although all the values recorder were above 300 ksi/in. sup 1/2, to increase the crack growth rate in fatigue and to show delaminations in fracture surface observation by SEM. The TRIP phenomenon explained correctly the strain rate effect and the assumption of hydrogen embrittlement explained the water effect. Author

N71-20086# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Physical and Engineering Metallurgy.
MARTENSITIC TRANSFORMATION IN A SPLAT COOLED METASTABLE Au-47.5 at. % Cd ALLOY
K. Mukherjee and Paul Ferraglio Oct. 1970 9 p refs Presented at the Intern. Conf. on Metastable Metallic Alloys, Yugoslavia, 28–30 Sep. 1970
(Contract N00014-67-A-0438-0002)
(AD-716043; TR-3) Avail: NTIS CSCL 11/6

The effects of liquid quenching on the martensitic transformation of an Au-47.5 at. % Cd alloy are studied. A metastable beta phase is retained at room temperature after splat quenching. The electron diffraction pattern of this metastable phase shows diffuse (112) streaking. The X-ray superlattice to fundamental line intensities are somewhat larger than the corresponding ratio for the bulk slow cooled samples (approximately 69C.). A reversible martensitic transformation can be induced in this metastable phase by increasing the beam intensity during the transmission electron microscopy. Extremely fine details of the martensitic plate nucleation and propagation during such a transformation cycle were recorded. Author (GRA)

N71-20091# Martin Marietta Corp., Baltimore, Md. Research Inst. for Advanced Studies.
ON THE CHEMISTRY OF THE SOLUTION AT THE TIPS OF STRESS-CORROSION CRACKS IN ALUMINUM ALLOYS
A. J. Sedriks, J. A. S. Green, and D. L. Novak Dec. 1970 24 p refs
(Contract N00014-67-C-0496)
(AD-716480; RIAS-TR-12-c; TR-4) Avail: NTIS CSCL 11/6

A study was made of the factors affecting the change of pH with time of initially acidic (pH = 0 to 2) 3% NaCl solutions, resulting from the dissolution of turnings of a commercial 7075 alloy, an Al-5.3 wt. pct. Zn-2.5 wt. pct. Mg alloy, and pure aluminum. It was shown that for solutions containing large volume fractions of the solids, a steady pH is attained which is associated with the onset of precipitation of Al(OH)3. It is suggested, by analogy, that the formation of the steady pH region at the tips of stress-corrosion cracks in aluminum alloys is also associated with the onset of precipitation of Al(OH)3, and that the pH in this region can be calculated from the solubility product of freshly precipitated 2Al(OH)3. The study also suggests that similar conclusions apply to the stress-corrosion cracking of magnesium alloys. Author (GRA)

N71-20207*# Faraday Labs., Inc., La Jolla Calif.
SPACE MEASUREMENTS OF THE CONTAMINATION OF SURFACES BY OGO-6 OUTGASSING AND THEIR CLEANING BY SPUTTERING AND DESORPTION
D. McKeown and W. E. Corbin, Jr. *In* NBS Space Simulation Oct. 1970 p 113–127 refs (See N71-20201 09-11)
(Contracts NAS5-11163; N00014-68-C-0373)
(NASA-CR-117138) Avail: NTIS; SOD $5.25 CSCL 11F

Results of the contamination of surfaces by outgassing of the OGO-6 satellite and the rates at which these surfaces are now being cleaned by sputtering and desorption after being in space for five months are given. It was found that the primary

source of outgassing on the satellite was its two solar panels baking out in the sun. The time constant for the exponential decay of the outgassing is 1,000 hours. The maximum amount of contamination adsorbed by the surfaces exposed to the outgassing was reached after five months in orbit and is 96 mg/sq cm for the Al surface and 52 mg/sq m for the Au surface. The contamination has a desorption activation energy of 26 kcal/g mol which falls into the energy range of materials, such as, expoxies and vacuum oils. The surfaces are undergoing cleaning by desorption and sputtering by upper atmospheric neutral impacts. Author

N71-20290# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

NOTES ABOUT NEUTRON RADIATION INDUCED SWELLING IN STAINLESS STEELS [NOTES DE LECTURE SUR LE GONFLEMENT SOUS IRRADIATION NEUTRONIQUE DES ACIERS INOXYDABLES]

Barre Bertrand Oct. 1970 95 p refs In FRENCH; ENGLISH summary

(CEA-N-1383) Avail: AEC Depository Libraries

In order to update the paper CEA-N-1064, notes are presented, summing up the main articles published about fast reactor radio-induced swelling in stainless steel. Information is included on measurement of reactor material swelling, theory of swelling, swelling of pure metals, irradiation by heavy ions, and simulation of defects on computers. Author (NSA)

N71-20306*# Techtran Corp., Glen Burnie, Md.

OXIDATION OF METALS IN AN UNSTEADY (TRANSIENT) REGION AT HIGH TEMPERATURES. 3: METHOD OF CALCULATING THE OXYGEN DIFFUSION COEFFICIENT IN A METAL (TITANIUM) [OKISLENIYE METALLOV V NESTATSIONARNOY (PERKHODNOY) OBLASTI PRI VYSOKIKH TEMPERATURAKH. 3: METOD RASCHETA KOEFFITSIYENTA DIFFUZII KISLORODA V METALLE (TITANE)]

V. I. Tikhomirov et al Washington NASA Mar. 1971 9 p refs Transl. into ENGLISH from Fiz. Metal. Metalloved. (USSR), v. 30, no. 1, 1970 p 111-115

(Contract NASw-2037)

(NASA-TT-F-13504) Avail: NTIS CSCL 11F

A method is presented for calculation of the diffusion coefficient of oxygen in metals with allowance for a shift of the interfacial phase boundary during oxidation. On the basis of data concerning the oxidation kinetics of titanium, the diffusion coefficient of oxygen in alpha titanium is calculated for temperatures ranging from 750 to 900 C. The diffusion activation energy within this temperature range is also tentatively estimated. Author

N71-20349# Japan Atomic Energy Research Inst., Tokyo.

ELECTRON MICROSCOPE STUDY OF NEUTRON IRRADIATION DAMAGE IN VANADIUM

Yoshio Katano, and Kiyoshi Fukaya Sep. 1970 30 p refs In JAPANESE; ENGLISH summary

(JAERI-Memo-4149) Avail: AEC Depository Libraries

The technique of transmission electron microscopy was used to study neutron irradiation damage and its behavior on annealing in vanadium. Foils were irradiated at 140 and 400 C to fast neutron doses of 1 × 10 to the 20th power/sq cm and 5 × 10 to the 19th power/sq cm, respectively. Point-defect clusters of approximately 85 A in diameter with approximately 1 × 10 to the 16th power/cu cm in density were observed in the specimen irradiated at 140 C. On annealing, the clusters grew as dislocation loops and the average diameter of the loop increased with decreasing in their density. In the specimen annealed for 1 hr at 560 C, the loops of 9 × 10 to the 14th power/cu cm in density had an average diameter of 370 A and are identified as faulted vacancy loops lying upon the {111} planes with a 1/2 ⟨111⟩ Burgers vector normal to the loop. The loops interacted on each other along dislocation lines upon heating at higher temperature (680 C) and disappeared finally (at 800 C). In the specimen irradiated at 400 C, faulted 1/2 ⟨111⟩ {111} loops were observed of approximately 250 A diameter with 2.3 × 10 to the 13th power/cu cm in density and most of the loops (approximately 80%) were identified as interstitial in character; the others are vacancy loops. Author (NSA)

N71-20390*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HYPERVELOCITY OXIDATION TESTS OF THORIA DISPERSED NICKEL CHROMIUM ALLOYS

Frank J. Centolanzi 11 Feb. 1971 52 p refs

(NASA-TM-X-62015) Avail: NTIS CSCL 11F

Hypervelocity oxidation tests of thoria dispersed nickel chromium alloys are described which are being considered for use on the space shuttle vehicle. Measurements of mass loss in both stagnation and wedge flows are presented, together with estimates of emissivity derived from radiometric measurements. The results of detailed metallurgical examination of the specimens are also shown. The results show that thoria dispersed nichrome (TD-NiCr) loses weight steadily with time in a hypervelocity environment. This loss of weight results in internal depletion of chromium accompanied by porosity. A modified alloy, containing aluminum and yttrium (TD-NiCrAlY), has superior oxidation resistance. Its emissivity, however, is considerably lower. Author

N71-20391*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

PRECIPITATION STRENGTHENED TANTALUM BASE ALLOY, ASTAR-811C

R. W. Buckman, Jr. and R. C. Goodspeed Washington NASA Mar. 1971 88 p refs

(Contract NAS3-2542)

(NASA-CR-1641; WANL-PR-(Q)-016) Avail: NTIS CSCL 11F

A creep resistant fabricable tantalum base alloy, Ta-8W-1Re-0.7Hf-0l025C (ASTAR 811C), was developed for potential use as structural and liquid alkali metal containment material in advanced Rankine cycle space nuclear power systems. Proceeding the discovery of the ASTAR-811C composition was a detailed study of the Ta-W-Hf-C alloy system with additions of Re, Mo, Zr, and N. Alloy compositions were selected with primary emphasis on improving high temperature creep properties and still maintaining good fabricating and weldability characteristics. All evaluations were performed on 0.04 inch sheet processed from ingot prepared by nonconsumable and consumable electrode arc melting. ASTAR-811C sheet material recrystallized one hour at 3000 F has 25% tensile elongation at -320 F. Recrystallized base metal and electron beam welded material exhibited 1t bend ductility at -320 F, while tungsten-inert-gas welded sheet is bend ductile at -175 to -250 F. ASTAR-811C and T-111 (Ta-8W-2Hf) exhibit similar fabricability and ductility characteristics, although the creep strength of ASTAR-811C is approximately double that of T-111 at 2400 F. Author

N71-20431# Bureau of Mines, Rolla, Mo. Metallurgy Research Center.

OXIDATION OF COBALT-NICKEL-ALUMINUM ALLOYS AT 1351 K TO 1429 K

Robert M. Doerr and James W. Jensen 1971 31 p refs

(BM-RI-7496) Avail: NTIS

The effect of aluminum alloy additions on the oxidation behavior of cobalt-nickel alloys was investigated. Thirty high-purity alloys were reacted with O sub 2 at 0.5 atm at 1,351, 1,389, and 1,429 K in a volumetric apparatus for about 300 min. The alloy compositions consisted of Co-Ni master alloys (0, 22, 50, 70, 91, and 100 wt pct Ni) with aluminum additions of about 0, 1, 2, 4, and 8 wt pct. Large early deviations from, or changes in, the

parabolic rate constant were encountered, but in most cases, the reaction rate declined approximately in accordance with the parabolic rate law. A sharp peak in the parabolic oxidation rate constant was observed for specimens containing 0 to 22 percent nickel and 1 to 2 percent aluminum at 1,351 K, and the rate constants for these compositions were lower at the higher temperatures. Specimens containing 8 percent aluminum reacted far more slowly than did any of the others. Author

N71-20444# National Research Council of Canada, Ottawa (Ontario).

EQUIVALENT EFFECT OF ADDED ELEMENTS ON THE SOLUBILITY, ACTIVITY AND ACTIVITY COEFFICIENT OF SULPHUR IN TERNARY AND MULTI COMPONENT ALLOYS, RICH IN IRON, AT 1600 C [AEQUIVALENT WIRKUNG VON ZUSATZELEMENTEN AUF LOESLICHKEIT, AKTIVITAET UND AKTIVITAETSKOEFFIZIENTEN DES SCHWEFELS IN EISENREICHEN DREI- UND MEHRSTOFF-LEGIERUNGEN BEI 1600 C]

E. Schuermann et al 1970 20 p refs Transl. into ENGLISH from Arch. Eisenhuettenw. (Dusseldorf), v. 38, no. 10, 1967 p 767–772

(NRC-TT-1418) Avail: NTIS

The effect of the alloying elements on the solubility and activity coefficient of sulphur in Fe-S-X sub i melts rich in iron was studied with the equivalent behavior of the added elements. Also investigated were the relation between the equivalence factor and activity parameters, and the equivalent behavior of the alloying elements in Fe-S-X sub 1 –X sub 2 .... X sub n melts. The experimental results found in literature, the interpretation and limits of the equivalence method are discussed. Author

N71-20449# Brandeis Univ., Waltham, Mass. Dept. of Physics.

PERTURBED ANGULAR CORRELATION MEASUREMENTS ON RHODIUM-100 IN A NICKEL HOST NEAR THE CURIE POINT

Robert C. Reno (Ph.D. Thesis) Oct. 1970 147 p refs

(Contract AT(30-1)-3823)

(TID-25597) Avail: NTIS

The temperature dependence of the hyperfine field at Rh-100 impurities in Ni was measured using the technique of time-differential perturbed angular correlations. Hyperfine fields were measured by observing the precession frequency of the 74.8 keV excited state moment, using the 84–74.8 keV gamma gamma cascade of the Rh-100 impurity. Standard slow–fast delayed coincidence circuitry was used with NaI(Tl) and plastic scintillators operating at optimum time resolution. Measurements were made over the temperature range 77 to 640 K with particular emphasis on field measurements near the Curie point. Data taken in the range (1-T/T sub c) less than 0.0006 was used to determine the critical exponent beta and to study the effect of small (2–15 G) externally applied fields on the Curie point behavior of the hyperfine field. A single value of beta (0.385 + or – 0.005) was found to hold over the temperature region 0.0001 less than (1 - T/T sub c) less than 0.1. Significant changes in the temperature dependence of the hyperfine field occur when external fields of greater than 6 G are applied in the temperature range .918 less than T/T sub c less than .9999. Author

N71-20453# Scientific Translation Service, Ann Arbor, Mich.

ANODIC OXIDATION OF THE Ti-Zr ALLOYS IN THE REGION BELOW THE OXYGEN EVOLUTION POTENTIAL

Koreaki Nakata et al [1970] 11 p refs Transl. into ENGLISH from Denki Kagaku (Japan), v. 37, May 1969 p 366–369

Sponsored by AEC

(AEC-tr-7201) Avail: NTIS

Ti, Zr and Ti–Zr alloys were anodized at potentials below the oxygen evolution level. The results obtained are consistent with the equation: $i(+) = A \exp BE$ where $i(+)$ is ionic current; E, field strength across the film and A and B are constants. The Ti–Zr alloy has a higher field strength for film growth at a given current density than the pure Ti and Zr. According to the Cabrella-Mott theory for very thin film growth, B is expressed by o lambda/kT, where q is the charge of the metal ion and lambda, the half-width of the potential energy barrier for metal ion migration. The lambda value for the specimens increased with increasing Zr content. This is consistent with the trend toward a higher lattice constant alpha sub 0 with increasing Zr content of the oxide. Author (NSA)

N71-20458*# TRW Equipment Labs., Cleveland, Ohio. Materials Technology Dept.

GENERATION OF LONG TIME CREEP DATA ON REFRACTORY ALLOYS AT ELEVATED TEMPERATURES Quarterly Report, 20 Jun. – 18 Sep. 1969

K. D. Sheffler 10 Oct. 1969 72 p refs

(Contract NAS3-9439)

(NASA-CR-72619; QR-21) Avail: NTIS CSCL 11F

Creep test results are reported for the molybdenum base alloy TZM, pure tantalum, and the tantalum base alloys T-111 and ASTAR 811C. Significant findings include the following: (1) A specially processed heat of TZM alloy, having a higher than normal carbon content and forged at higher than normal temperatures, continues to show creep strength superior to conventionally processed TZM alloy. (2) Accelerated creep in the heat affected zone of a bead-on-plate TIG weld in pure tantalum results from grain growth which takes place in this region during welding. (3) The creep strength of a commercial heat of ASTAR 811C alloy was found superior to laboratory heats of this material. (4) An expression was developed for an Inconel 718 alloy, proposed for a radioisotope capsule application, to predict variable stress, variable temperature creep behavior. D.L.G.

N71-20462*# Ohio State Univ. Research Foundation, Columbus.

STRESS CORROSION CRACKING OF TITANIUM ALLOYS Semiannual Report, 1 Jan. – 30 Jun. 1970

F. H. Beck and M. G. Fontana Dec. 1970 118 p refs

(Grant NGL-36-008-051; RF Proj. 2267)

(NASA-CR-117177; Rept-8) Avail: NTIS CSCL 11F

The hydrogen embrittlement of titanium as related to stress-corrosion cracking (SCC) was studied in the pick up of hydrogen from aqueous environments at room temperature and the spontaneous and strain induced hydrides which precipitate in supersaturated alpha titanium were investigated by transmission electron microscopy. The initiation and propagation of SCC are discussed. It is concluded that: (1) Initiation is an electrochemically dependent process. (2) Ti-6A1-4V pits at cathodic potentials in a 5N HC1 environment. Application of stress changes the mode of attack from the beta phase to the alpha at the alpha-beta interface. (3) Titanium picks up hydrogen very rapidly at the potential and in the environment assumed at the crack tip. (4) Hydrogen is absorbed more rapidly on polished surfaces and in more highly stressed regions. F.O.S.

N71-20503*# Ottawa Univ. (Ontario). Dept. of Chemistry.

STUDIES ON ELECTROCHEMICAL FORMATION AND REDUCTION OF OXIDE FILMS ON NOBLE AND TRANSITION METALS Interim Report

H. A. Kozlowska and W. Sharp 20 Dec. 1970 74 p refs

(Grant NGR-52-093-001)

(NASA-CR-117192) Avail: NTIS CSCL 11F

Surface oxidation of Pt electrodes was studied in very pure solutions, and various stages of the uptake of O by the surface were resolved. The reversibility with respect to various stages in the formation and reduction of the surface oxide layer was investigated in relation to the activity of the surface for organic oxidation reactions. The stages of surface oxidation are related to the geometries of various sublattices of O on the Pt surface rather than to specific stoichiometries of Pt-O surface compounds. Optical

studies by means of ellipsometry show that in pure solutions and with sensitive instrumentation there is no distinguishability, with respect to potential dependence, between the change of optical properties and the change of the surface coverage determined by surface coulometry. There is a close correlation down to the lowest coverages that can be detected at about 0.8 V. The present results agree with those from the modulated reflectance technique. The experimental procedure for investigating Pt surface oxidation was developed further and a satisfactory special type of autogenous H2 electrode was fabricated and tested. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N71-19491# Drexel Univ., Philadelphia, Pa. Wave Propagation Research Center.

MEASUREMENTS OF SHOCK HUGONIOT IN UNIDIRECTIONAL FIBER REINFORCED COMPOSITES. PART 2 Technical Report, Apr. 1969–Jun. 1970

F. K. Tsou and B. S. Holmes Wright-Patterson AFB, Ohio AFML Nov. 1970 42 p refs

(Contract F33615-68-C-1419)

(AD-716560; AFML-TR-69-152-Pt-2) Avail: NTIS CSCL 11/4

The shock wave generated by a planar impact of a flyer plate and propagated along the direction of the fibers of a composite was studied. The sample composite used in the experiments was made of unidirectional aluminum fibers cast in an epoxy matrix. Both the shock wave velocity and the free surface velocity were measured by means of an optical technique. It was found that the shock wave velocity was independent of the shock travel, i.e., a steady shock front. The results of the measured Hugoniot also give a satisfactory comparison with those obtained from an analysis proposed in an earlier work. The present measurements may therefore be used to substantiate that analytical study. Author (GRA)

N71-19492# Princeton Univ., N.J. Frick Chemical Lab.

THE VOLUME CHANGE ACCOMPANYING RUBBER EXTENSION

James C. Goebel and Arthur V. Tobolsky Nov. 1970 12 p refs

(Contract N00014-67-A-0151-0011)

(AD-716565; ONR-TR-RLT-128) Avail: NTIS CSCL 7/4

A new expression for the volume dilation accompanying rubber extension is used to describe published data. This new equation is shown to describe the data better than either that derived from simple kinetic theory or that derived from the Mooney-Rivlin Equation. Author (GRA)

N71-19671 Stanford Univ., Calif.

THE BAND STRUCTURE OF POTASSIUM GRAPHITE (C8K)

Rosemarie Murdock Frost Swanson (Ph.D. Thesis) 1969 113 p Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 70-1613

A brief survey of some properties of the alkali graphites is given with a critical discussion and description of the structure of the compound C8K. The method (tight-binding) of calculating the band structure is described including the band structure and Fermi surface derived from these calculations. Estimates of the values of a number of parameters are cited, such as the density of states at the Fermi surface (0.09 states/eV per atom), the work function (2.76V), the Knight shift of potassium in C8K (40% of the shift in potassium metal), the percent ionization of the potassium (11%), and the coefficient of electronic specific heat (1.17 mJ/mole-sq deg). In addition, the superconductivity of the alkali graphites is discussed in terms of a previously proposed theory and an estimate of their maximum superconducting transition temperature (17 K) is made. Dissert. Abstr.

N71-19616# Polytechnic Inst. of Brooklyn, N.Y.

PERMEABILITY OF GASES THROUGH FILLED AND UNFILLED RUBBER MEMBRANES

G. Y. Lei and F. R. Eirich Oct. 1970 160 p refs

(Contract N00014-67-A-0438-0010)

(AD-716393; PIBAL-70-44) Avail: NTIS CSCL 11/10

The document reports on a study, by way of gas permeation experiments, of the structural differences between synthetic poly-cis 1,4-isoprene and natural rubber, and the differences arising from filling these rubbers with carbon black. Author (GRA)

N71-19628# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF BORON NITRIDE ON FRICTION AND WEAR OF TUNGSTEN

Ye. A. Dzhafarov 4 Sep. 1970 11 p refs Transl. into ENGLISH from Nauchn. Konf. Aspirvantov Inst. Problem Materialovedeniya, (USSR), 1968 p 166–175

(AD-716525; FTD-HT-23-442-70) Avail: NTIS CSCL 11/8

Tests were made on friction and wear for W plus 10, 15, and 20 percent BN. Tests were made at given slip rates. The friction path was 10,500m. The low wear value for all of the tested compounds is due to the presence of a solid phase in the form of W boride. The decrease in the friction coefficient with increasing pressure, observed for the W plus 15 percent BN sample, is due to an intensification of the separation of the nitride phase and its dissociation products during the friction process. The decomposition of the nitride goes more slowly for increasing pressure than for increasing slip rate, which is related with the specific difference in the effect of rate and pressure on the friction temperature. Increasing the amount of B nitride over 15 percent does not improve the antifriction properties of the pair. Author (GRA)

N71-19665# Oak Ridge National Lab., Tenn.

BIBLIOGRAPHY WITH ABSTRACTS ON CARBON-CARBON AND ASSOCIATED COMPOSITES

F. M. O'Hara, Jr. and J. L. Cook Oct. 1970 30 p refs

(Contract W-7405-eng-26)

(ORNL-4598) Avail: NTIS

The results of a search of Scientific and Technical Aerospace Reports and International Aerospace Abstracts for the period 1965 to July 1970 are presented. The terms searched under were ablation, ablative material, ablative nose cones, carbon, composite materials, composite structures, graphite, heat shielding, nose cones, reentry shielding, reentry vehicles, and rocket nose cones. Literature on carbon-carbon, carbon-graphite, and graphite-graphite composites was sought primarily, but literature on metal-matrix/carbon-reinforced composites and metallic-carbide composites with either a carbon, graphite, or metal matrix was noted also. These have been grouped under the headings Carbon – Carbon Composites, Metallic-Carbide Composites, and Metal-Matrix Composites. No interest was taken in composites incorporating glass or plastics. A number of abstracts were used from the Ceramic Awareness Bulletin. Author (NSA)

N71-19667# Naval Ordnance Lab., White Oak, Md. Nonmetallic Materials Div.

SYNTHESIS OF POLYQUINOXALINES CONTAINING SULFONYL GROUPS IN THE POLYMER CHAIN

J. M. Augl and W. J. Wrasidlo 3 Sep. 1970 16 p refs

(AD-716025; NOLTR-70-113) Avail: NTIS CSCL 7/3

A series of seven new polyquinoxalines containing sulfonyl groups in the chain was synthesized. Five of these were phenylated polyquinoxalines. These are all high temperature stable materials. Their polymer decomposition temperatures do differ, however, and range from 430 to 520C depending on differences in chemical structure. Phenylated polyquinoxalines show markedly higher solubilities than their nonphenylated analogs; they also have far better thermal-oxidative stability. Author (GRA)

N71-19676# Naval Ordnance Lab., White Oak, Md.

COMPARISON OF MECHANICAL AND ACOUSTIC PROPERTIES FOR SELECTED NONFERROUS, FERROUS, AND PLASTIC MATERIALS

Stuart L. Hanlein, William M. Hinckley, and Frederick P. Stecher 1 Jul. 1970 115 p refs

(AD-716033; NOLTR-70-141) Avail: NTIS CSCL 11/6

Mechanical and acoustic properties have been tabulated for 356 nonferrous, 173 ferrous, and 67 plastic materials. These properties include density, Youngs modulus of elasticity, ultimate tensile strength, yield strength, strength-to-density ratio, elastic sound speed, and acoustic impedance. The tabulation was accomplished by means of a computer program. The limited number of materials and material properties presented allows the user to make an initial selection. Further information on similar materials should be obtained from other sources. Author (GRA)

N71-19677*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A STATUS REVIEW OF LEWIS RESEARCH CENTER SUPPORTED PROTECTION SYSTEM DEVELOPMENT

S. J. Grisaffe, J. P. Merutka, and S. R. Levine [1971] 13 p refs Presented at 18th Refractory Composite Working Group, Huntsville, Ala., 16–18 Mar. 1971; sponsored by NASA and US Air Force

(NASA-TM-X-52977) Avail: NTIS CSCL 11C

The status of several Lewis Research Center sponsored coating research and development studies is reviewed. Efforts on protecting superalloy and dispersion strengthened materials for aircraft gas turbine engines and on protecting refractory metals for reentry systems are discussed. Author

N71-19681*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

REPORT ON THE FLIGHT PERFORMANCE OF THE Z-93 WHITE PAINT USED IN THE SERT 2 THERMAL CONTROL SYSTEM

N. John Stevens and George R. Smolak [1971] 13 p refs Proposed for Presentation at the 6th Thermophysics Conf., Tullahoma, Tenn., 26-28 Apr. 1971; sponsored by AIAA

(NASA-TM-X-52970; E-6177) Avail: NTIS CSCL 11C

The change in absorptance of the 1.8 square meters of Z-93 white paint applied as the primary component of a passive thermal control system is evaluated by varying the paint absorptance values used in a calibrated computer model of the satellite until the resulting temperatures matched the flight data. This absorptance change is determined for a 6200 hour, constant sunlight period in a 1000 kilometer orbit and found to have increased by 0.04 as expected. It has been concluded that inadvertant contamination has caused higher degradation of one area. This area of higher degradation has not caused thermal problems. Hence, the white paint system is functioning satisfactorily. Author

N71-19690# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ENGINEERING METHOD OF EVALUATING THE SUPPORTING STRENGTH OF STRUCTURAL ELEMENTS FROM GLASS REINFORCED PLASTIC OPERATING IN CONDITIONS OF TEMPORARY UNSTEADY HEATING

M. G. Lozinskii et al 19 Oct. 1970 16 p refs Transl. into ENGLISH from the publ. 'All-Union Scientific Technical Conference 5th, Kiev, Dec. 1967' Kiev, Akad. Nauk Ukr. SSR, Inst. Problem Prochnosti, 1969 p 374–382

(AD-716515; FTD-MT-24-229-70) Avail: NTIS CSCL 11/9

The combination of high mechanical features of glass reinforced plastic with low temperature transfer allows their successful use in highly stressed constructions, which operate briefly at elevated temperatures (of the order of several thousands of degrees). However, the inadequate development of methods of determining the supporting power of fiberglass under these conditions of service hampers the designing of such constructions. Attempts to create anaylytical or numerical methods of calculating the supporting power of such material encounter considerable difficulties connected with the complexity of constructing a physical model of the weakening of glass reinforced plastic under conditions of intensive unsteady heating and solving the system of equations sufficiently describing phenomena occurring in this case in the object under study, and also the absence of data about the temperature dependence of thermophysical and mechanical characteristics of polymeric material. Author (GRA)

N71-19691# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE NATURE OF THE REACTION OF REFRACTORY METALS WITH GRAPHITE DURING SPRAY COATING

V. I. Kostikov et al 2 Sep. 1971 13 p refs Transl. into ENGLISH from Fiz. Khim. Orab. Mater. (Moscow), no. 1, 1969 p 80–85

(AD-716516; FTD-HT-23-369-70) Avail: NTIS CSCL 11/3

The report studies the kinetics of the chemical interaction of the transition metals Ti, Nb, and Mo with graphite. It is shown that in the process of combining a coating with a base the stage of chemical reaction is first realized, after which diffusion processes occur. Author (GRA)

N71-19727*# Rensselaer Polytechnic Inst., Troy, N.Y.

STRUCTURAL CHARACTERIZATION

In its Mater. Res. Sep. 1970 p 3–24 refs (See N71-19726 09-32)

Avail: NTIS CSCL 11I

The research in the structure of materials is reported. Topics presented include: relaxation in polymers at low temperatures, polymer-solvent interactions, solution properties of polymers, thermodynamics of polymer solutions, phase equilibria in solid regions of inorganic materials, physical properties of hard tissues and biomedical materials, and laser fusion bonding of ceramics. F.O.S.

N71-19730*# Rensselaer Polytechnic Inst., Troy, N.Y.

ELECTRONIC AND PHYSICAL PROPERTIES OF MATERIALS

In its Mater. Res. Sep. 1970 p 56–68 (See N71-19726 09-32)

Avail: NTIS CSCL 11B

The thermal and elastic properties of polymers, and the electronic properties of glasses and metals were studied. Thermal capacities of polymers were measured at temperatures above the melting point, where there appears to be an unexpected influence of premelted history, and at liquid He temperatures, where the emphasis is on that portion coming from local modes. This quantity appears as an excess over the Debye contribution which is determined by ultrasonic measurements of elastic wave velocities. Studies of thermal conductivity are also being made at high temperatures to investigate anisotropy in specially prepared polymer crystals and in addition in low temperature regime as well. Relaxation technique has been applied to glasses doped with iron oxides to explore the conduction mechanism. There appears to be some evidence of electron hopping. Mossbauer measurements of

internal, hyperfine magnetic fields are being applied to solutions of iron in zinc to explore spin fluctuation in this nonmagnetic system and studies of iron in the molybdenum-niobium system are being used to determine the onset of magnetic moment as a function of composition. Author

N71-19733*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE APPLICATION OF THERMOELECTRIC DEVICES AS SPACECRAFT THERMAL CONTROL COATINGS

J. M. Clemons and A. C. Krupnick 25 Feb. 1971 26 p refs

(NASA-TM-X-64570) Avail: NTIS CSCL 11C

An elementary introduction to thermoelectric devices is given. The figure of merit and associated factors are subsequently discussed. Theoretical calculations with bismuth telluride as a semiconductor model are exhibited, and a basic scheme for deposition of a thin film array as a thermal control coating is presented. In addition, the thermal constraints of Skylab are presented as a means of example for the utilization of active thin film thermoelectric array devices. Author

N71-19803# Newcastle-upon-Tyne Univ. (England). Dept. of Metallurgy.

THE BRITTLE FRACTURE OF ALLOYED ALUMINA Final Technical Report, Aug. 1969 –Aug. 1970

J. Congleton, L. M. Linnett, and N. J. Petch Sep. 1970 25 p refs

(Contract DAJA37-70-C-0195)

(AD-715988; ARDG(E)-E-1420) Avail: NTIS CSCL 11/2

A hot-pressing facility was commissioned and fabrication procedures established for the manufacture of high density, fine grained pure and alloyed alumina. Mechanical testing of the products, by four point bend tests, has commenced. A suitable chemical analysis procedure for determining Cr in alumina has been developed that is accurate to within plus or minus 0.5 micrograms Cr. Additionally, a theoretical consideration of the notch strength of alumina has been developed. This is based on a simple model for fracture and suggests that the mechanistic details of fracture nucleation close to the notch tip are of significant importance in determining the relationship between notch-strength and stress concentration factor at a blunt notch. Author (GRA)

N71-19804# Technione - Israel Inst. of Tech., Haifa. Dept. of Materials Engineering.

LONGITUDINAL STRENGTH OF UNIDIRECTIONAL FIBROUS COMPOSITES Final Technical Report, Jan. 1968 –Feb. 1970

Jacob M. Lifshitz and Assa Rotem Wright-Patterson AFB, Ohio AFML Sep. 1970 94 p refs

(Contract F6105268-C-0015)

(AD-716629; MED-25; AFML-TR-70-194) Avail: NTIS CSCL 11/4

Theoretical and experimental investigation of the longitudinal strength of unidirectional fiber reinforced composite has been performed. The fibers are treated as having variable strength which results in fiber fractures prior to composite failure. The matrix is treated as a linear viscoelastic material. A new model based on the cumulative weakening model has been developed and analyzed mathematically. The size effect is included in the analysis and the proposed failure mechanism agrees with observed failure geometry. The effect of length on strength is found to be very small. Unidirectional glass reinforced epoxy and reinforced polyester specimens with 60% volume fraction of fibers were tested in tension at three temperatures (25C, 78C and 130C) and a wide time range; from creep (more than a month) to impact tests. The composite strength under impact conditions was found to be about three times higher than under static conditions. This increase in strength is due to the glass fibers, the strength of which is rate sensitive. The fibers and matrix materials were also tested seperately at similar conditions to the composite material and their mechanical properties are presented. Author (GRA)

N71-19823# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EFFECT OF LUBRICANTS WITH FILLERS ON WEAR OF A DIAMOND INSTRUMENT DURING COLD DRAWING OF WIRE

I. G. Fuks et al 9 Oct. 1970 12 p refs Transl. into ENGLISH from Neftepererabotka i Neftekhimiya, (USSR), no. 9, 1969 p 20–23

(AD-716523; FTD-HT-23-467-70) Avail: NTIS CSCL 11/8

The wear of diamond draw-plates was determined as the length of Mo wire that could be drawn before the diameter of the wire had increased by 1 mu. Lubricants used were a mineral oil, castor oil with a surfactant, Li ricinoleate, and Li sterate. Fillers used were mica, graphite, and MoS2. Filler particle size was 20-40 and 120-150 mu. Without fillers, the castor oil reduced wear more effectively than the mineral oil. Li ricinoleate was superior to Li sterate. When the fillers were used alone without a carrier was 2-3 times more effective than graphite, and mica had no positive effect at all. Increasing the particle size reduced some what the protection against wear. Lubricants made of each of the 3 fillers in each of the 2 oils were all superior to the oils alone. Optimum results were obtained with 30 percent MoS2 in castor oil. The mode of action is discussed. Author (GRA)

N71-19824# Union Carbide Corp., San Diego, Calif. Crystal Products Dept.

MANUFACTURING PROCESS FOR LARGE SHEETS OF TRANSPARENT SINGLE CRYSTAL ALUMINUM OXIDE BY THE CZOCHRALSKI METHOD Final Report, 1 Nov. 1968–31 Oct. 1969

G. A. Keig and J. M. J. Watts 25 Nov. 1970 37 p

(Contract DAAG46-69-C-0002)

(AD-716622; AMMRC-CR-69-20(F)) Avail: NTIS CSCL 19/4

The Czochralski technique was developed for the growth of single crystal aluminum oxide in plate form for transparent armor applications. A description of the growth process is given along with an assessment of the optical quality. Growth was described for two plate sizes, and the problems associated with crystal growth for both sizes are discussed. With the intermediate size plate, particular emphasis has been placed on the improvement of crystalline shape and optical qualities. A plate in unfinished form with dimensions 4 in x 8 in x 1/2 in thick was grown successfully and forwarded to the government for their inspection. With the exception of in-line transmission towards the UV end of the visible spectrum, the optical properties for this plate fell well within the stated specifications for the material. Growth was carried out from the large crucible and a plate with approximate dimensions of 6 in x 6 in x 1/2 in thick obtained. The material was single crystal, although some further development work is required in order to improve the optical quality. The problems of fabricating the large size plate was considered and the development work along these lines described. Author (GRA)

N71-19949# Army Foreign Science and Technology Center, Washington, D.C.

STABILIZATION OF POLYORGANOSILOXANES BY MEANS OF FERROCENE DERIVATIVES [STABILIZATSIYA POLIORGANOSILOKSANOV PROIZVODNYMI FERROTSENA]

G. S. Tubyanskaya et al 8 Jul. 1970 8 p refs Transl. into ENGLISH from Plasticheskie Massy (Moscow), no. 10, 1969 p 21–22

(AD-716621; FSTC-HT-23-979-70) Avail: NTIS CSCL 7/3

The longevity and also maximum application temperatures of rubbers, plastics, varnishes and lubricants based on polyorganosiloxanes depend upon the stability of these materials

relative to the oxygen of the air, especially at higher temperatures. Therefore as a rule the above products contain stabilizers. Three ferrocene derivatives are discussed which are highly effective in polyorganosiloxanes. Thermooxidation destruction stability of the polymethylsiloxane PMS-100 at 250 degrees C increases 800 times and at 300 degrees C-400 times. The ferrocene derivatives investigated are also effective when added to PFMS-4--gelatinization time at 300 degrees C increases from 165 to 1,070-1100 hours. Subject ferrocene derivatives are recommended as oxidation inhibitors for polyorganosiloxanes. Author (GRA)

N71-19950# Ballistic Research Labs., Aberdeen Proving Ground, Md. Terminal Ballistics Lab.

SHOCK INDUCED ELECTRICAL SIGNALS WITH POSITIVE AND NEGATIVE COMPONENTS

G. E. Hauver Nov. 1970 29 p refs

(AD-716329; BRL-2074) Avail: NTIS CSCL 11/7

Shock-induced electrical signals from polyethylene were examined within the framework of the Allison polarization theory, and have been found to consist of both positive and negative components. The similarity to certain shock-induced electrical signals from alkali halide crystals is noted, and hypothetical signals were calculated to display the basic features of a few alkali halide signals selected from the literature. The calculations suggest that signal profiles may not provide a clear indication of shock-wave transit time when both positive and negative components are present. Author (GRA)

N71-20027# Advisory Group for Aerospace Research and Development, Paris (France).

HANDBOOK OF BRITTLE MATERIAL DESIGN TECHNOLOGY

W. H. Dukes Feb. 1971 161 p refs

(AGARD-AG-152-71; AGARDOGRAPH-152) Avail: NTIS

Structural data on brittle nonmetallic refractory materials such as oxides, carbides, borides, and graphite are provided for use in designing reentry vehicles and propulsion systems. The term brittle materials is used to describe materials which show no plastic deformation under stress, but deform elastically until failure. The principles and practices for achieving reliability with structures constructed with brittle materials are described in detail. Design stresses, stress analysis, mechanical properties, and design criteria are discussed. F.O.S.

N71-20046# Ballistic Research Labs., Aberdeen Proving Ground, Md.

AN ELECTROMAGNETIC MEASUREMENT OF THE SHOCK HUGONIOT OF TEFLON

Robert E. Franz Nov. 1970 18 p refs

(AD-716333; BRL-MR-2075) Avail: NTIS CSCL 11/9

The shock Hugoniot of Teflon (polytetrafluorethylene) has been measured using an electromagnetic technique which provided a direct measurement of both shock and particle velocities. Thin conductors, spaced along the shock path within the Teflon were moved through an impressed magnetic field at the local mass velocity. The emf's induced across the moving conductors were related to the particle velocity and the time interval between signals was related to the shock velocity. Experimental data, in the pressure range from 100 to 270 kilobars, were represented by the linear relationship, U sub s = 1.12 + 1.95 U sub p, where U sub s is the shock velocity and U sub p is the particle velocity. Author

N71-20089*# Techtran Corp., Glen Burnie, Md.

THE CHEMICAL TREATMENT OF GLASS SURFACES [UVEGFELULETEK KEMIAL KEZELSE]

Gyorgy Koranyi Washington NASA Feb. 1971 19 p refs Transl. into ENGLISH from Kem. Kozlem. (Budapest), v. 29, no. 4, 1968 p 407-420

(Contract NASw-2037)

(NASA-TT-F-13437) Avail: NTIS CSCL 11B

The processes and treatments used in the chemical treatment of glass are characterized both by operation and by substances utilized. The effects are described in terms of mechanical and chemical properties improved or produced. These include such properties as breaking strength, resistance to abrasion and chemical action, and hydrophobic reaction. Author

N71-20170# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.

QUANTITATIVE ANALYSIS OF URANIUM BASED CERAMIC MATERIALS BY MEANS OF X-RAY DIFFRACTION

R. Conti (Ph.D. Thesis - Paris Univ., Orsay, France) 22 Apr. 1970 76 p refs In FRENCH

(EUR-4518) Avail: AEC Depository Libraries

X-ray diffraction is used for the quantitative analysis of uranium-based ceramic materials. A study was made of the various factors on which quantitative analysis depends, namely the grain size of the powders, preferential orientation effects, the method of assembling the samples, and the degree of crystallization of the products. With the use of the various X-ray diffraction methods the ceramic materials were determined in each other and in their mixtures with accuracy (within + or - 2% for 50 to 100% concentrations). These main methods were divided into two categories: comparative methods and internal standard methods. The comparative methods were used for analyzing the binary mixture UO2-U3O8, for determining traces of U3O8 in UO2, UO2 in UC, and for analyzing the binary mixture UC-UC2. The accuracy obtained was within + or - 2% for the high concentrations (50 to 100%) and within about 6% for the 0 to 50% concentrations. Author (NSA)

N71-20202*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MOLECULAR CONTAMINATION IN ENVIRONMENTAL TESTING AT GODDARD SPACE FLIGHT CENTER

J. C. Goldsmith and E. R. Nelson *In* NBS Space Simulation Oct. 1970 p 1-24 refs (See N71-20201 09-11)

(NASA-TM-X-66936) Avail: NTIS; SOD $5.25 CSCL 11C

A discussion of the various techniques used to detect and analyze materials outgassing from a spacecraft during the environmental test is presented. In addition, a number of compounds that have been detected and their parent outgassing sources are listed. The two major methods for reducing the threat of contamination (i.e., proper choice of spacecraft materials and proper operation of the test facility) are also discussed. Author

N71-20220# Naval Civil Engineering Lab., Port Hueneme, Calif.

EFFECT OF PHOTODEGRADATION ON ORGANIC COATINGS

Peter J. Hearst *In* NBS Space Simulation Oct. 1970 p 299-312 refs (See N71-20201 09-11)

Avail: SOD $5.25

Clear and pigmented coating films were irradiated with a mercury arc, a xenon arc, and sunlight. Strips of the free films, consisting chiefly of alkyd, vinyl, and epoxy coatings, were exposed in a quartz chamber. The major volatile product, as determined by infrared spectroscopy, was carbon dioxide, but the products varied depending on the irradiation, the pigmentation, and the type of coating. Internal reflection spectra indicated primarily the formation of carbonyl groups, and the greatest changes were obtained for coatings that did not have high initial carbonyl absorption. Author

N71-20222# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).

SOME PROBLEMS CONCERNING THE SIMULATION OF

PLASTIC FILMS DEGRADATION BY IONIZING RADIATIONS

A. J. Paillous and Ph. Fayet (CNES) *In* NBS Space Simulation Oct. 1970 p 323–344 refs (See N71-20201 09-11)
Avail: SOD $5.25

Simulation of the action of polyenergetic proton-and electron-fluxes encountered in space is necessary for a convenient estimate of polymeric film materials. The following points were experimentally investigated on ethylene terephtalate films irradiated in a vacuum by 1.5 MeV-protons and by 0.35-, 0.6-, 2.0 MeV-electrons: (1) dose rate effects; (2) effects of interruptions during irradiation; (3) recovery during post-irradiation exposures to air or to vacuum; (4) effect of the sample temperature during irradiation; (5) effect of particles- energy; (6) effect of the particles' nature. It is concluded that accelerated tests in a vacuum can be used to predict the damage created during missions in Space which are of a longer duration. Author

N71-20225*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.

THE DEGRADATION OF ALZAK BY SHORT WAVELENGTH ULTRAVIOLET RADIATION

M. J. Donohoe, Roy McIntosh, Jr., and John H. Henniger *In* NBS Space Simulation Oct. 1970 p 383–392 refs (See N71-20201 09-11)
(NASA-TM-X-66941) Avail: NTIS; SOD $5.25 CSCL 11D

UV induced degradation of Alzak was found to be inversely proportional to wavelengths between 220nm and 300 nm. UV and vacuum UV exposures at selected wavelengths between 123.6nm and 300nm indicate degradation to be inversely proportional to wavelength down to 185 nm. Equivalent exposure to 123.6nm radiation however, produced less degradation indicating a change in the damage dependency below 185 nm. Degradation of up to 12% change in reflectance at 295nm is reported for Alzak exposed to less than 50 equivalent sun hours of vacuum UV radiation. Author

N71-20226*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

THE PHOTO RESPONSE AT AN ALKALINE PAINT INTERFACE WITH ALUMINUM

Walter A. Wappaus *In* NBS Space Simulation Oct. 1970 p 393–402 refs (See N71-20201 09-11)
(NASA-TM-X-66942) Avail: NTIS; SOD $5.25 CSCL 11C

A spacecraft coating comprised of aluminum oxide and potassium silicate applied to an aluminum alloy (6061) substrate and subsequently partially coated with evaporated gold electrodes, develops a measurable potential between the substrate and the gold electrodes. This effect is observed when the coating is in darkness and in vacuum. When the coating is irradiated in situ with UV shorter in wavelength than 3600 Angstroms, the current and voltage is found to increase. Upon exposure to prolonged irradiation this current level decays exponentially with time. The voltage similar decays with time in an exponential manner indicating that photo-degradation of the electronic transport properties is occurring. The transport mechanism proposed to account for this behavior is a migration of protons toward the aluminum substrate and negative hydroxyl ions toward the gold electrodes resulting in the electrolysis of water in the coating. Author

N71-20373*# Los Alamos Scientific Lab., N.Mex.

CMF-13 RESEARCH ON CARBON AND GRAPHITE Summary Report, 1 Aug. –31 Oct. 1970

Morton C. Smith Feb. 1971 32 p refs Sponsored in part by NASA
(Contract W-7405-ENG-36)
(NASA-CR-117315; LA-4631-MS; Rept-15) Avail: NTIS CSCL 11D

Research and development on carbon and graphite were undertaken to increase understanding of their properties and behavior as engineering materials, to improve the raw materials and processes used in their manufacture, and to learn how to produce them with consistent, predictable, useful combinations of properties. Microstructural, physical, and mechanical properties are measured as functions of formulation, treatment, and environmental variables, and correlations are sought among properties and structures. Raw materials and manufacturing techniques are investigated, improved, and varied systematically in an effort to create specific internal structures believed to be responsible for desirable combinations of properties. Author

N71-20402*# Boeing Co., Seattle, Wash. Research and Engineering Div.

EXPERIMENTAL IN SITU INVESTIGATION OF THE EFFECTS OF PROTONS, ULTRAVIOLET RADIATION, AND TEMPERATURE ON THERMOPHYSICAL PROPERTIES OF SOLAR CELL FILTERS AND OTHER SPACECRAFT MATERIALS

Lawrence B. Fogdall and Sheridan S. Cannaday Feb. 1971 142 p refs Prepared for TPL
(Contract NAS7-100)
(NASA-CR-117365) Avail: NTIS CSCL 11D

An investigation was conducted to determine in situ the effects of ultraviolet radiation and solar wind protons on materials considered for use on the 1973 Venus-Mercury flyby vehicle. The experimental program involved more than 2400 hours of continuous radiation-facility testing, preceded, interrupted, and followed by in situ thermophysical property measurements on transmissive solar cell filters, opaque solar cell-filter stacks, adhesives, 7940 fused silica, and Kapton film. Sun rate, solar wind rate, and sample temperature were all increased with time during the 2400 hours, providing an accurate simulation of radiation conditions along the planned flyby trajectory. Final exposure levels of 12,000 ESH and 10 to the 16th power protons/sq cm were reached. Solar absorptance increased and solar transmittance decreased in most solar cell filters. The solar absorptance of solar cell-filter stacks also increased. Changes measured in solar cell filters were generally less than changes measured on solar cell-filter stacks. Both ultraviolet and proton exposure reduced the effectiveness of the ultraviolet rejection coatings in the solar cell filters. In some materials, simultaneous exposure to protons and ultraviolet radiation yielded synergistic damage greater than the sum of proton degradation and ultraviolet degradation in separate samples. Thermal damage in unbonded Kapton film was catastrophically large. Author

N71-20432*# General Electric Co., Cincinnati, Ohio. Nuclear Systems Programs.

EFFECT OF VACUUM LEVEL ON SOLAR RECEIVER MATERIALS Final Report

T. F. Lyon 10 Oct. 1970 118 p refs
(Contract NAS3-11828)
(NASA-CR-72845; GESP-578) Avail: NTIS CSCL 11D

Resistively heated strip specimens of Cb-1Zr alloy were exposed at 1700 F (927 C) in a vacuum chamber at various levels of total pressure in the 0.000001 torr range. Pressure levels were maintained by controlled in-leakage of air. Oxygen reacted rapidly with Cb-1Zr alloy under these conditions and final oxygen content of the specimens was between 4000 and 9000 ppm for exposure times between 200 and 500 hours. Oxygen sticking probabilities were found to depend on whether or not the specimens were annealed immediately before the test exposure. Sticking probabilities ranged from 0.65 on the clean surface to 0.16 on the surface with the oxide film. Mechanical tests of the contaminated material showed that Cb-1Zr alloy is considerably strengthened by homogeneous addition of oxygen to an oxygen level of about 6000 ppm, while still maintaining reasonably good room temperature

ductility. At higher oxygen levels, the ductility decreased markedly with little additional increase in strength. The weld metal is brittle after homogeneous addition of 4300 ppm oxygen. Author

N71-20455*# California Univ., Berkeley. Sea Water Conversion Lab.
STUDY OF PERMEABILITY CHARACTERISTICS OF MEMBRANES Quarterly Report
K. S. Spiegler, R. M. Messalem, R. J. Moore, and J. Leibovitz 15 Oct. 1970 29 p refs Prepared for JPL
(Contracts NAS7-100; JPL-952109)
(NASA-CR-117367; QR-11) Avail: NTIS CSCL 11G

The experimental results presented are based on the transport measurements achieved with the concentration-clamp method, developed especially for precise measurements of water and electrolyte transport through membranes under the influence of electric, osmotic and pressure forces or any combination thereof. A refined set of transport equations has been derived in terms of J sub w and J sub s, water and salt flux respectively, rather than the previous and time-honored use of volume flux, J sub V, which turns out to be a non-conservative flux, because of the non-negligible variation of the partial molar volumes of water and electrolyte with the concentration. Water and salt permeabilities were calculated, as well as respective transport numbers. In order to compare with previous researchers by others (in which some, but not all transport phenomena were measured), the results are also given in terms of practical transport coefficients; namely the reflection coefficient, the hydraulic permeability, and the solute permeability. Author

N71-20459*# Thiokol Chemical Corp., Brigham City, Utah. Wasatch Div.
LOW COST CARBONACEOUS DEVELOPMENT Final Report
S. H. Cardall Mar. 1971 210 p refs
(Contract NAS3-12034)
(NASA-CR-72833) Avail: NTIS CSCL 11D

Low cost graphite powder and phenolic resin molding compounds for use in rocket motor nozzle applications were developed. The mechanical properties were improved and the density and thermal conductivity of previously developed low cost carbonaceous materials were reduced. Four formulations were developed which compare favorably with the original low cost carbonaceous materials and conventional carbon cloth and silica cloth preimpregnated broad goods type nozzle insulators. Author

N71-20536# California Univ., Livermore. Lawrence Radiation Lab.
PRELIMINARY LEVEL ANALYSIS OF THE FIRST AND SECOND SPECTRA OF DYSPROSIUM: Dy 1 AND Dy 2
John G. Conway and Earl F. Worden Aug. 1970 613 p refs
(Contract W-7405-eng-48)
(UCRL-19944) Avail: NTIS

Accurate wavelengths and wave numbers of over 22,000 dysprosium lines were measured in the wavelength region 2300 to 11,400 A. The Zeeman effect was observed at a field strength of 24,000 G from 2300 to 9000 A. By comparison of relative intensities of the lines from sources under various conditions, 85% of the lines were assigned as Dy(I) or Dy(II) spectrum lines. From the energy level analysis, 141 even and 197 odd levels of Dy(I) are known. Combinations between these levels account for 1952 lines. For Dy(II) 14 even and 214 odd levels are known with 1000 lines classified. The ground levels of Dy(I) and Dy(II) are 4f10 6s2 5I8 and 4f10 6s 6I8-1/2, respectively. The lowest level of the 4f9 5d 6s2 configuration of Dy(I) lies 7565.62/cm above the ground level. The G-values for most of the levels of both spectra are given. Author

N71-20594# Oak Ridge National Lab., Tenn.
THORIUM CERAMICS DATA MANUAL. VOLUME 2: NITRIDES
Sigfred Peterson and C. E. Curtis [1970] 13 p refs
(Contract W-7405-eng-26)
(ORNL-4503-Vol-2) Avail: NTIS

Chemical, mechanical and physical properties of thorium nitrides, alone and in combination with other nitrides and other thorium compounds, are collected from the literature through January 1970 (35 references). The thorium-nitrogen phase equilibrium is reviewed. Author (NSA)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N71-19490# North Carolina Univ., Chapel Hill. Dept. of Statistics.
STABILITY AND EXPONENTIAL PENALTY FUNCTION TECHNIQUES IN NONLINEAR PROGRAMMING
John P. Evans and Floyd J. Gould Nov. 1970 22 p refs /ts Mimeo Ser. No. 723
(Contract N00014-67-A-0321-0003)
(AD-716564) Avail: NTIS CSCL 12/2

In the paper, one develops the concept of a general exponential penalty function as a method of solving inequality constrained optimization problems. Relationships to the concept of stability in nonlinear programming are presented together with results on approximate solutions and bounds on the optimal value of a program. Conditions are stated which guarantee that sequences of penalty function maximizers will yield optimal solutions to the original programming problem. Author (GRA)

N71-19517 New Mexico State Univ., University Park.
SOME CONSISTENCY AND HIGH ENERGY THEOREMS IN STOCHASTIC FIELD THEORY
Peter Paul Yodzis, Jr. (Ph.D. thesis) 1969 87 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 70-1695

Several exact results in Ingraham's stochastic field theory are obtained. It is shown that 1) the well known Schwinger term ambiguities of local field theory are absent from stochastic field theory, 2) the equal time commutators of a stochastic current with the fields with which it interacts can be zero, 3) the theorems of Coleman on current-generated broken symmetries hold only in part for stochastic currents. A lemma on the high energy behavior of Fourier transforms of matrix element of retarded products of stochastic operators is provided. This lemma is applied to 1) total scattering cross sections, where it is shown that the leading term allowed by the lemma gives constant total cross sections at very high incident energies, in accord with experiment, 2) nucleon electromagnetic form factors. Dissert. Abstr.

N71-19519# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
PHARMACOKINETICS WITH UNCERTAINTIES IN RATE CONSTANTS
T. T. Soong Dec. 1970 17 p refs
(Grants NIH GM-16197-03; NSF GK-1834X)
(TR-70-60) Avail: Issuing Activity

The compartmental analysis in pharmacokinetics when uncertainties in knowledge of the rate constants are taken into account is considered. The rate constants are taken as random variables and the joint probability distribution of the drug concentrations are determined. The significance of this stochastic approach is illustrated by simple compartmental models.

N71-19572# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.

THEORY OF NONLINEAR WAVES

Joachim M. Schmid 15 Oct. 1970 40 p refs

(Contract F61052-70-C-0014)

(AD-716530; UNICP-SR74; AFOSR-70-2728TR) Avail: NTIS CSCL 12/1

The paper is a review of papers which handle nonlinear waves with an averaging technic developed by Whitham. If it is possible to derive the differential equations governing the problem from a variational principle the Lagrangian can be averaged over one period. From the averaged Lagrangian averaged conservation equations are derived and from these one finds a second order differential equation in terms of frequency, wavenumber and amplitude - that is a dispersion equation. Besides the frequency dispersion an amplitude dispersion occurs too. The distortion of the waveform depends on whether the Dispersion equation is elliptic or hyperbolic. The nonlinearity may produce phase jumps and discontinuities of the wavenumber. Author (GRA)

N71-19662# Massachusetts Inst. of Tech., Cambridge. Dept. of Mathematics.

CONSTRUCTION OF NON-LINEAR LOCAL QUANTUM PROCESSES, 1

Irving Segal Nov. 1970 39 p refs

(Contract F44620-67-C-0008)

(AD-716585; AFOSR-70-2831TR) Avail: NTIS CSCL 12/1

A species of singular perturbation theory applicable to a general class of nonlinear local quantum fields is developed. The theory is applied in detail to the arbitrary scalar relativistic field in two space time dimensions with positive-energy self-interaction. Author (GRA)

N71-19688# Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.

STUDY OF WEAKLY NONLINEAR DYNAMICAL SYSTEMS AND THEIR STABILITY Interim Technical Report, 16 Sep. 1969 - 15 Sep. 1970

P. R. Sethna 3 Nov. 1970 5 p refs

(Grant AF-AFOSR-704-66)

(AD-716538; AFOSR-70-2735TR) Avail: NTIS CSCL 12/1

The fundamental results of the Method of Averaging have been generalized in a manner so that new mathematical results are suitable for application to a large class of problems arising in applications. Gyroscopic systems with large conserved momenta are studied using the theory of singular perturbation. A new mathematical result valid for finite time has been obtained. The results of the mathematical analysis are applicable to gyroscopes devices with high spin. Author (GRA)

N71-19848# Tulane Univ., New Orleans, La.

STOCHASTIC CHARACTERISTICS FOR PARABOLIC EQUATIONS

Edward D. Conway [1969] 13 p refs

(Grant NSF GP-12722)

Avail: Issuing Activity

It is known that there is a deep relationship between stochastic processes and parabolic partial differential equations. Probabilistic aspects of non-linear parabolic equations have been uncovered in which there is a pointwise representation of solutions of a differential equation as an expectation. Unfortunately, these formulas have been presented in a rather ad hoc fashion and there seems to be an opinion that the probabilistic aspects are ancillary if not accidental. To help counter this attitude, a unified way of deriving these formulas directly from the differential equation is offered. The model is the characteristic theory for first order partial differential equations. Author

N71-19884# Tulane Univ., New Orleans, La. Dept. of Mathematics.

ON THE GROWTH OF SOLUTIONS OF INHOMOGENEOUS ABSTRACT WAVE EQUATIONS

Jerome A. Goldstein [1970] 8 p refs

(Grant NSF GP-19824)

Avail: Issuing Activity

An exponential bound for the growth of the norm of the derivative of the strong solution of an inhomogeneous abstract wave equation is considered in a Banach space. In the case of a skew-adjoint operator on a Hilbert space, it is shown that the energy norm of the solution remains bounded in time. Author

N71-19915*# Texas Technological Univ., Lubbock. Dept. of Industrial Engineering.

APPLICATION OF EMPIRICAL BAYES DECISION PROCEDURES TO DISCRETE TIME LINEAR FILTERING. INVESTIGATION OF AN EMPIRICAL BAYES FILTER FOR USE IN TRAJECTORY ESTIMATION Final Report

S. J. Kamat and H. F. Martz, Jr. Dec. 1970 143 p refs

(Grant NGR-44-011-031)

(NASA-CR-114897; QT-70-001) Avail: NTIS CSCL 12A

A smooth emperical Bayes filter was developed for estimating the state vector of a discrete time linear system with linear sets of observations. The distributional assumptions on the state disturbance error as well as those on the initial state vector were relaxed. The performance of the filter is examined by means of Monte Carlo simulation of a realistic problem in trajectory estimation. It is found that the filter's performance does not depend significantly on the form of the state disturbance used in the simulation. In comparison with the performance of the Kalman filter, the smooth emperical Bayes filter demonstrated a better performance when used with a U-shaped distribution on the components of the state disturbance error. It is also observed that the performance of the Bayes filter depends on the relative magnitudes of the covariance matrices of the state disturbance error and the observation error. D.L.G.

N71-19938# California Univ., Livermore. Lawrence Radiation Lab.

DIFFERENCE METHODS FOR HYPERBOLIC EQUATIONS USING SPACE AND TIME SPLIT DIFFERENCE OPERATORS OF THIRD ORDER ACCURACY

Samuel Z. Burstein and Arthur A. Mirin 5 Oct. 1969 11 p refs Presented at the 2d Intern. Conf. on Numerical Methods in Fluid Dyn., Berkeley, Calif. Submitted for publication Sponsored by AEC

(UCRL-72806; CONF-700906-3) Avail: NTIS

Additional results obtained using third order difference methods are presented. The methods had been tested on a one dimensional shock problem and a two dimensional scalar problem. The linear stability theory gave good bounds on the range of allowable steps and allowed for accurate determination of the artificial viscosity parameters. Results are given on a nonlinear two dimensional problem requiring the integration of a system of equations: the conservation laws of fluid dynamics. Author

N71-19995# Joint Inst. for Nuclear Research, Dubna (USSR).

RELATIVISTIC THREE-BODY PROBLEM IN CONFIGURATION REPRESENTATION

V. M. Vinogradov 1970 22 p refs In RUSSIAN

(JINR-P2-5101) Avail: AEC Depository Libraries

On the basis of the three-dimensional formulation of the quantum field theory, the configuration space in the relativistic three-body problem is introduced. A finite-difference analog of the Schrodinger equations in terms of relative variables is obtained. On the basis of these equations a relativistic generalization of the

Faddeev integral equations for the wave function is formulated. Difficulties caused by the integral character of the relations between the relative variables are pointed out. Author (NSA)

N71-20001# Joint Inst. for Nuclear Research, Dubna (USSR).
THREE-DIMENSIONAL COVARIANT FORMULATION OF THE THREE-BODY PROBLEM IN QUANTUM FIELD THEORY
V. M. Vinogradov 1970 22 p refs In RUSSIAN
(JINR-P2-5099) Avail: AEC Depository Libraries

On the basis of the three-dimensional formulation of quantum field theory, the relativistic analog of the Faddeev equations for scattering amplitude are obtained. The system satisfies three-body unitarity and the correspondence principle. Author (NSA)

N71-20011# Manchester Univ. (England). Dept. of Mathematics.
ON THE OPTIMAL CONTROL OF STATIONARY DIFFUSION PROCESSES WITH NATURAL BOUNDARIES AND DISCOUNTED COST
R. Morton Oct. 1970 21 p refs
(RR-24/RM/3) Avail: NTIS

Results were obtained for one-dimensional diffusion processes with discounted cost. The stronger assumption that at least one of the inaccessible boundaries is natural made possible the solution of a differential equation corresponding to the future expected cost function. A step by step proof of the theorems required for the solution is presented. Author

N71-20073# Tokyo Univ. of Education (Japan). Dept. of Physics.
SCALE TRANSFORMATIONS OF THE SECOND KIND AND THE WEYL SPACE TIME
M. Omote 1970 7 p refs
(TUEP-70-32) Avail: NTIS

Based on the assumption that the world is a curved space-time for which the gravitational field is partly responsible, it is shown that scale transformations can be generalized to those of the second kind by adopting Weyl's geometry for the space-time. An example of Lagrangians is presented, which is invariant under both general coordinate and scale transformations. Author

N71-20093# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
S-MATRIX THEORY OF THE LAMB SHIFT. 2
X. Artru and M. Fontannaz Dec. 1970 60 p refs
(Rept-70/41) Avail: NTIS

The S-matrix theory and the Dashen-Frautschi technique were applied to the Lamb shift. The contributions in alpha(Z alpha) to the 4th power of the nonrelativistic cuts, which correspond to the Bethe logarithm and to the anomalous magnetic moment term, are estimated. The approximate value of the Bethe logarithm is 3.25 for the 2S state, and we get change in kinetic energy, E, for 2S = 980 MHz. For the anomalous magnetic moment term, analyticity assumptions lead to an exact result. The approximate value of the change in E for 2P1/2 is + 7 MHz. The radiative corrections to the low energy Compton amplitude (for spin 0 particles) were obtained using dispersion relations. Author

N71-20134# Advisory Group for Aerospace Research and Development, Paris (France).
UNCONSTRAINED MINIMIZATION APPROACHES TO CONSTRAINED PROBLEMS
R. L. Fox *In its* Structural Design Appl. of Mathematical Programming Tech. Feb. 1971 p 55-78 refs (See N71-20128 09-32)
Avail: NTIS

Several unconstrained minimization methods are discussed, and their advantages and disadvantages are presented. The basic idea of these methods is to convert the constrained problem, with its objective function and equality and inequality constraints, into a problem in which some new function is minimized without regard for constraints. The solution to the original problem is developed through a sequence of unconstrained minimizations. The reliability of the algorithms, their sequential nature, and the straightforward formulation and implementation of these methods are described. Formulations employing interior penalty functions are discussed in order to apply the unconstrained minimization methods to the solution of the constrained problem. Formulations employing exterior penalty functions, and penalty functions for equality constraints are also mentioned. N.E.N.

N71-20135# Advisory Group for Aerospace Research and Development, Paris (France).
FEASIBLE DIRECTION METHODS
J. S. Kowalik *In its* Structural Design Appl. of Mathematical Programming Tech. Feb. 1971 p 79-93 refs (See N71-20128 09-32)
Avail: NTIS

Algorithms for solving a general nonlinear programming problem and which have proved to be successful and applicable to structural optimization problems are discussed. The advantages and disadvantages of the methods are compared from theoretical and computational viewpoints. Zoutendijk's usable feasible directions method efficiently reduces the problem to a sequence of linear programming problems, is finite for quadratic programming problems, and can handle nonconvex problems. A modified feasible directions method utilizes some ideas of the cutting plane method. Rosen's gradient projection method uses projections of the objective function gradient into the manifold defined by currently active constraints. The method works with vectors which are feasible and usable, and replaces linear optimization subproblems with matrix inversion schemes. Gellatly's optimum vector method determines the direction of search from a set of simultaneous linear equations, which can be solved by the stable Choleski decomposition method. N.E.N.

N71-20137# Advisory Group for Aerospace Research and Development, Paris (France).
SPECIAL PURPOSE APPLICATIONS
L. A. Schmit *In its* Structural Design Appl. of Mathematical Programming Tech. Feb. 1971 p 102-123 refs (See N71-20128 09-32)
Avail: NTIS

A few examples of mathematical programming applications to specific structural design problems are described. The examples discussed point up the important role structural optimization can play in evaluating alternative design concepts and materials based upon a comparison of optima. The stiffened cylindrical shell optimization capability is reviewed in some detail. The extension of this capability to shells with slight meridional curvature is briefly discussed and two recently reported special purpose applications to fiber composite structures are noted. Application of an integrated penalty function approach to the optimum design of an ablating composite type heat shield is described. Author

N71-20200# Tulane Univ., New Orleans, La.
PASSAGE TIMES FOR A NONSINGULAR ONE-DIMENSIONAL DIFFUSION
Steven I. Rosencrans 20 Aug. 1970 3 p refs
Avail: NTIS

A simple derivation of the distribution of passage times for a nonsingular one-dimensional diffusion satisfying the (Ito) stochastic differential equation is presented. Author

N71-20274 Tulane Univ., New Orleans, La.
A STRUCTURE THEOREM FOR (C SUB o) CONTRACTION SEMIGROUPS ON HILBERT SPACE

Jerome A. Goldstein Jul. 1970 11 p refs
Avail: NTIS

The following theorem is proved: Let T = (T sup t: t > or = 0) be a (C sub o) contraction semigroup on a Hilbert space H. The T is quasi-similar to an orthogonal direct sum T of T1 and T2 of (C sub o) contraction semigroups on a Hilbert space sum of H1 and H2. Author

N71-20275# Tulane Univ., New Orleans, La.
STOCHASTIC EQUATIONS WITH DISCONTINUOUS DRIFT
Edward D. Conway [1969] 21 p refs
(Grants NSF BP-12722; NSF GP-19824)
Avail: Issuing Activity

The stochastic equation dx = a dt + sigma d beta where a is the drift coefficient and sigma is the diffusion matrix, is considered. The definition of a previous solution is relaxed, making possible a theory for discontinuous direction fields. Theorems are proved concerning the existence of relaxed solutions, one-sided uniqueness, and approximation of relaxed solutions. N.E.N.

N71-20304# Tulane Univ., New Orleans, La.
ON BOUNDED SOLUTIONS OF ABSTRACT DIFFERENTIAL EQUATIONS
Jerome A. Goldstein [1969] 7 p refs
(Grant NSF GP-12722)
Avail: Issuing Activity

The compactness condition of a previously published theorem is investigated. A semigroup of bounded linear operators (T sub t: t > or = 0).is constructed on a Banach space such that T sub t converges strongly to zero as t approaches infinity. It is shown that the compactness condition on the resolvent of the infinitesimal generator of the semigroup cannot be removed. N.E.N.

N71-20329# Tulane Univ., New Orleans, La.
AN EXTREMAL PROPERTY OF STOCHASTIC INTEGRALS
Steven Rosencrans 28 May 1970 11 p refs
(Grant NSF GP-12722)
Avail: Issuing Activity

A nonanticipating Brownian functional that is essentially bounded with respect to both the time and the Brownian paths is considered. It is proved that the functional e approaches Ef(y sub t) attains its maximum value at the constant function e = 1, where E is the expectation (integral over the space of Brownian paths with Weiner measure), and y sub t is the stochastic (Ito) integral of e. As a corollary, new and sharp bounds on the moments of the stochastic integral are obtained. The essential ingredient in the proof is the use of Ito's lemma to convert a hyperbolic equation of inequality for a function h(x,t) into a parabolic equation or inequality for H(x,t): = Eh(x,y sub t). Author

N71-20340# Manchester Univ. (England). Dept. of Mathematics.
ON THE RELATION BETWEEN SOME METRIC INVARIANTS FOR MARKOV SHIFTS
W. K. Hayman (London Univ.) and S. M. Rudolfer Oct. 1970 28 p refs
(RR-23/SMR/1) Avail: NTIS

Properties of invariants in a sequence (alpha sub n) from zero to infinity of metric invariants for infinite-measure-preserving Markov shifts are studied in detail, and their relationship to the classifcal invariant of entropy is examined. The relation between the quantitites (alpha sub n)(p) and h(S sub p) for any null-recurrent renewal sequence p is investigated. It is found that the relation is not strong. However, if (p sub n) is always large, then h(S sub p) is finite. Author

N71-20341# Illinois Univ., Urbana.
EXTRAPOLATION AND INTERPOLATION OF QUASI LINEAR OPERATORS ON MARTINGALES
D. L. Burkholder and R. F. Gundy (Illinois Univ. and Hebrew Univ. of Jerusalem) [1970] 87 p ref
(Grants NSF GP-8727; NSF GP-8056)
Avail: Issuing Activity

A new method to obtain one-sided and two-sided integral inequalities for a class of quasi-linear operators is introduced. Some assumptions are similar to those of the Marcinkiewicz interpolation theorem. However, in contrast to that theorem, the operators studied here are local in a certain sense and are usually most conveniently defined on martingales. In fact, the suitable choice of starting and stopping times for martingales, together with the systematic use of maximal functions and maximal operators, is central to the method. Author

N71-20372*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
ADAPTIVE STOCHASTIC CONTROL FOR LINEAR SYSTEMS. PART 2: ASYMPTOTIC PROPERTIES AND SIMULATION RESULTS
Michael Athens and Edison Tse (Systems Control, Inc.) 1 May 1970 55 p refs Reprinted
(Grants NGL-22-009-124; AF-AFOSR-1724-69)
(AD-706939; NASA-CR-117182; PUBL-70C-58-AC-Pt-2) Avail: NTIS CSCL 12/1

The problem considered in this two-part paper deals with the control of linear, discrete-time, stochastic systems with unknown (possibly time-varying and random) gain parameters. The philosophy of control is based on the use of an open-loop-feedback-optimal (O.L.F.O.) control using a quadratic index of performance. in Part I it is shown that the O.L.F.O. system consists of (1) an identifier that estimates the system state variables and gain parameters, and (2) by a controller described by an adaptive gain and correction term. Several qualitative properties of the overal system are obtained from an interpretation of the equations. Part II deals with the asymptotic properties of the O.L.F.O. adaptive system and with simulation results dealing with the control of stable and unstable third order plants. Comparisons are carried out with the optimal system when the parameters are known. In addition, the simulation results are interpreted in the context of the qualitative conclusions reached in Part I. Author (GRA)

N71-20381# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
EQUIVALENCE THEOREM AND OBSERVABLES IN THE FIELD THEORY
I. V. Polubarinov 1970 10 p refs In RUSSIAN
(JINR-P2-5266) Avail: AEC Depository Libraries

The field theory remains invariant with respect to any substitutions of the field variables and unitary representations (equivalence theorem). From the point of view of quantum mechanics principles it is unnecessary to exploit the asymptotic conditions in proving the equivalence theorem. This is an emergency method since in realistic theories, as a rule, a complete set of observables can only be constructed at the included interaction. Author (NSA)

N71-20382# Oak Ridge National Lab., Tenn. Mathematics Div.
KWIC INDEX FOR THE NUMERICAL TREATMENT OF NONLINEAR EQUATIONS
A. S. Householder Nov. 1970 129 p refs
(Contract W-7405-eng-26)
(ORNL-4595) Avail: NTIS

An index of reports, papers, and books relevant to the numerical treatment of algebraic and transcendental equations is presented. Author (NSA)

N71-20413*# Translation Consultants, Ltd., Arlington, Va.
PARTIAL ELLIPTICAL DIFFERENTIAL EQUATIONS

L. Schwartz Washington NASA Mar. 1971 83 p refs Transl. into ENGLISH of the book "Ecuaciones Diferenciales Parciales Elipticas" Bogota, Natl. Univ. of Colombia, 1956 84
(Contract NASw-2038)
(NASA-TT-F-13417) Avail: NTIS CSCL 12A

An explanation of differential and hypoelliptical operators is given and discussed are: pre-Hilbertion spaces; elliptical and hypoelliptical spaces (with a demonstration of the fundamental theorey); the distribution sections of fibrated spaces with vectorial fibers; and differential operators over fibrated spaces. Examples of the Laplacian operator and its elliptical nature are demonstrated and the theorems of quasi-monomorphism and A-elliptic equations are presented. Author

N71-20537# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
A SURVEY OF RANDOM METHODS FOR PARAMETER OPTIMIZATION
R. C. White, Jr. [1970] 26 p refs
(Rept-70-E-16) Avail: NTIS

A class of algorithms known as random search methods was developed for obtaining solutions to parameter optimization problems. A guide is given to the literature in this area. Some of the theoretical results obtained are described as well as the development of practical algorithms. Brief descriptions of the problems associated with inequality constraints, noisy measurements, and thslocation of the global optimum are included. An attempt is made to indicate types of problems for which random search methods are especially attractive. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N71-19442# Weather Squadron (24th), Detachment 7, Mather AFB, Calif.
TERMINAL FORECAST REFERENCE FILE FOR MATHER AIR FORCE BASE, CALIFORNIA Final Report
30 Oct. 1970 46 p
(AD-716545) Avail: NTIS CSCL 4/2

The report discusses factors affecting the Weather at Mather AFB, California. Included are location and topography, weather controls, climatic aids, and local forecast studies. Author (GRA)

N71-19482# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NUMERICAL METHODS OF WEATHER FORECASTING [CHISLENNYE METODY V PROGNOZE POGODY]
G. I. Marchuk 23 Oct. 1970 397 p refs Transl. into ENGLISH from the Russian
(AD-716497; FTD-HC-23-433-69) Avail: NTIS HC $6.00/MF $0.95 CSCL 4/2

The monograph presents new numerical methods of forecasting weather several days in advance. These methods are based on a complete system of equations of hydro- and thermodynamics, taking atmospheric moisture transfer and radiational effects into account. The mathematical model uses a method of separating the compound operators of the problem to yield simpler ones. A description is given of effective algorithms for the numerical solution of a system of equations for weather forecasting, and their theoretical basis is described. The majority of the results presented in the monograph are being published for the first time. Author (GRA)

N71-19612# Kansas State Univ., Manhattan. Water Resources Research Inst.
MICROMETEOROLOGICAL INVESTIGATION OF THE ENERGY BUDGET: EFFECT OF SUMMER WINDS Project Completion Report, 1 Jul. 1966 – 30 Jun. 1970
E. L. Skidmore, H. S. Jacobs, L. J. Hagen, and W. L. Powers Oct. 1970 70 p refs
(PB-195927; OWRR-A-005-KAN-1) Avail: NTIS CSCL 04B

Summer wind enhances potential evapotranspiration in the Great Plains by a large but predictable amount. This high potential evaporation can be reduced by windbreaks or barriers. Windbreaks reduce evaporation rates from a wet surface proportionably to windspeed reduction with a proportionality constant usually less than 0.5. Use of windbreaks for reducing windspeed causes other changes in the microclimate. The highest humidity and humidity gradients, highest daytime air temperature lowest nightime air temperature, and generally the steepest temperature gradients all occurred in the areas where the windbreak reduced windspeed to the lowest level. The absolute humidity was lower at 12 times the windbreaks height leeward than in the open field. These findings indicate that windbreaks lower the evaporative demand and induce a more favorable environment for plant growth in the harsh climate of the Great Plains. Author (GRA)

N71-19622# Air Force Cambridge Research Labs., Bedford, Mass.
OBJECTIVE ESTIMATE OF THE CLIMATOLOGY OF VERY TALL CONVECTIVE CLOUDS: A NEGATIVE REPORT
Arthur J. Kantor 6 Nov. 1970 14 p refs *Its* Environ. Res. Papers No. 336
(AD-716388; AFCRL-70-0611) Avail: NTIS CSCL 4/2

An objective method has been developed for determining the occurrence and altitude of tall convective clouds for the purpose of construction of a global climatology of such clouds. The particular computer program selected is the version that produced maximum cloud-top estimates in closest agreement with highest radar precipitation echoes for a three-year period at Miami, Fla., Lake Charles, La., New York, N. Y., and Oklahoma City, Okla. A day-by-day comparison of radar echoes and computed cloud tops reveals such numerous and sufficiently large discrepancies that the computerized parcel method does not appear satisfactory for providing a climatology of convective clouds above 40,000 ft Author (GRA

N71-19623# GCA Corp., Bedford, Mass. Technology Div.
ATMOSPHERIC ELECTRIC AND LIGHTNING DETECTOR Final Report, Feb. 1969 – Mar. 1970
John Dulchino Nov. 1970 77 p refs
(Contract F19628-69-C-0201)
(AD-716534; GCA-TR-70-4-A; AFCRL-70-0544) Avail: NTIS CSCL 4/1

A system has been developed to monitor both the atmospheric potential gradient and also the occurrence of cloud to ground lightning discharges. The instrument consists of an outdoor sensor package and an indoor display unit. The potential gradient measurement is obtained using a conventional field mill which is contained in the sensor package. The lightning detector circuitry consists of a plate antenna and a narrow band ac amplifier which monitors the low frequency components of the electromagnetic signal generated by lightning discharges. A description of the equipment is presented along with an analysis of the various circuit elements. Operating procedures and results from early measurements are included. Author (GRA)

N71-19627# Air Weather Service, Scott AFB, Ill.
SOME TECHNIQUES FOR SHORT-RANGE TERMINAL FORECASTING
Clay G. Russell Sep. 1970 52 p refs
(AD-716391; AWS-TR-233) Avail: NTIS CSCL 4/2

The report describes several techniques applicable to short-range terminal forecasting. Areas discussed are procedures for graphical extrapolation, nephanalysis, forecasting frontal precipitation, and the lowering of ceilings during precipitation. The use of FPS-77 radar and weather satellite data is shown as they pertain to short-range forecasting. Author (GRA)

N71-19636*# Aerojet Electrosystems Co., Azusa, Calif. Analytical Research Lab.

COLLECTION AND MEASUREMENT OF ATMOSPHERIC TRACE CONTAMINANTS Final Report

C. L. Deuel and M. L. Moberg [1970] 72 p

(Contract NAS1-9814)

(NASA-CR-111851) Avail: NTIS CSCL 04B

The 90-day manned test with the simulated space station required the measurement of trace chemical constituents of the air within the simulator. A description is given of the methods and apparatus used for air sampling, sample handling and analysis; analytical results are presented. More than 100 constituents were identified and qualitatively measured using gas chromatography, mass spectrometry, and high vacuum rack manipulation. Author

N71-19659# Air Force Cambridge Research Labs., Bedford, Mass.

PHYSICOCHEMICAL PROPERTIES OF SOME HYGROSCOPIC NUCLEI

Bruce A. Kunkel 19 Oct. 1970 59 p refs *Its* Environ. Res. Papers No. 337

(AD-716384; AFCRL-70-0626) Avail: NTIS CSCL 4/2

The report contains all necessary information for determining the growth behavior of 37 hygroscopic materials under all temperature and humidity conditions. A condensation growth rate equation is presented. The physicochemical properties that are required for inclusion in the growth equation are tabulated for the various chemicals. Author (GRA)

N71-19660# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STRUCTURE OF TEMPERATURE FIELD IN TURBULENT FLOW

A. M. Obukho 9 Oct. 1970 22 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Izv. Ser. Geogr. i Geofizicheskaya (USSR), v. 13, no. 1, 1949 p 58–69

(AD-716507; FTD-HT-23-394-70) Avail: NTIS CSCL 4/2

The mean square of the temperature difference at two points of flow is used as the characteristic of the temperature field structure. The relationship between this quantity and the distance between observation points is determined theoretically. The order of magnitude of the characteristics of the temperature pulsation field in the atmosphere is evaluated. Author (GRA)

N71-19661# Manchester Univ. (England). Dept. of Physics.

THE ROLE OF ELECTRICAL FORCES IN THE DEVELOPMENT AND DISSIPATION OF CLOUDS AND FOG Final Technical Report

John Latham and M. H. Smith Nov. 1970 43 p refs

(Contract DAJA37-71-C-1117)

(AD-716362; ARDG(E)-E-1430) Avail: NTIS CSCL 4/2

The purpose of the study was to determine whether the disruption of freely falling drops, principally by electrical forces, could initiate freezing; to establish the physical basis of this phenomenon; and to assess its meteorological relevance. From the experimentation it was concluded that the freezing of supercooled drops may be facilitated by disruption of the drop in an electric field and is not dependent upon the presence of a support. The passage of a spark to the drop at the time of disruption does not appear significantly to affect the nucleation process. Experiments were also performed in which falling supercooled drops were disrupted by means of an air jet in the absence of electrical forces. Photographs obtained in the same manner as in the primary experiments provided no evidence for the presence of ice in the drops, but these studies were too cursory to be definitive. Author (GRA)

N71-19714# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.

RESEARCH AND ENGINEERING DEVELOPMENT AND EVALUATION OF ICE NUCLEI DISPERSION SYSTEMS Final Report, 1 May 1967–1 May 1970

1970 100 p refs (Contract DI-14-06-D-6170)

(PB-196149) Avail: NTIS CSCL 04B

The development of ground and airborne steady state-type ice nuclei generators for field application is described. A review of the state of the art indicated a need for a new design in ground and airborne steady state generators. Performance, reliability, ease of maintenance, simplicity, and cost were necessary conditions for improvements as was a need for units capable of remote operation. Design parameters of a prototype generator with improved performance are described; nucleating materials, carriers, and fuels are discussed; and results of extensive field tests are given. Author (GRA)

N71-19765*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

THE SEMIANNUAL VARIATION IN THE HETEROSPHERE: A REAPPRAISAL

L. G. Jacchia Jan. 1971 16 p refs

(Grant NGR-09-015-002)

(NASA-CR-117137) Avail: NTIS CSCL 04B

It is shown that the semiannual variation in the heterosphere can be represented as a pure density variation whose amplitude is a function of height. Attempts to represent the semiannual density variation in the heterosphere as a consequence of temperature variation have run into difficulties in two height regions: below 200 km and above 1000 km. The main argument in favor of the temperature variations was the dependence of their amplitude on the solar cycle; it is shown that this dependence is spurious, being caused by the variation of the density change with the temperature. An analysis of the semiannual density variations at different height levels fails to show a dependence on the amplitude with the sunspot cycle. All difficulties are removed if it is assumed that the semiannual density variation is not a direct consequence of temperature variations. Author

N71-19826# Technische Hochschule Aachen (West Germany). Forschungsstelle fuer Geophysik und Meteorologie.

THE EDDY TRANSFER OF ACTIVE AND PASSIVE CONTAMINANTS IN THE ATMOSPHERIC BOUNDARY LAYER Final Technical Report

H. Israel, M. Horbert, and C. De La Riva Nov. 1970 215 p refs

(Contract DAJA-37-69-C-1348)

(AD-716359; ARDG(E)-E-1263) Avail: NTIS CSCL 4/2

Concluding the first phase of the present research program on atmospheric eddy transport, the following items are delivered: Eddy transport of thoron in open terrain and in a forest; Eddy viscosity and eddy conductivity from wind and temperature profiles, respectively; Comparison of the three different eddy transport parameters; Evaluation calculi and methods (in theory and in practice); Theoretical studies and considerations concerning the effect of additional convective transport; and Theoretical considerations concerning several fundamental points of the description of random and turbulent motion. Author (GRA)

N71-20024# Brookhaven National Lab., Upton, N.Y.

RISE OF BUOYANT CLOUDS

J. A. Frizzola, I. A. Singer, and M. E. Smith May 1970 19 p

refs Sponsored by AEC
(BNL-50244) Avail: NTIS

The open burning of rocket propellant fuel served as a source of buoyant clouds whose dimensions were measured photographically and visually. Repeated experiments produced consistent cloud behavior during temperature inversions, while showing the expected variability during lapse conditions. Analyses of the time and space history of the cloud tops established the usefulness of a method for distinguishing the initial cloud behavior from the subsequent expansion of the cloud caused by ambient turbulence. Since the heat release, cloud behavior, and meteorological factors were known, it was possible to study their interrelation and to make comparisons with theory. Author

N71-20096# Finnish Meteorological Office, Helsinki.
AERONAUTICAL CLIMATOLOGICAL CONDITIONS AT LAPPENRANTA AERODROME
Ilona Soini 1970 39 p refs
(Rept-25) Avail: NTIS

Tabulated data covering the period 1 December 1957 to 30 November 1962 are presented for the Lappeenranta airport, Finland. Ceiling, visibility, surface wind, and weather information are grouped by various periods of the day and by various temperature and wind categories. Diurnal and seasonal distributions are included for wind direction and temperature. Precipitation and fog observations are also shown. J.M.

N71-20097# Finnish Meteorological Office, Helsinki.
AERONAUTICAL CLIMATOLOGICAL CONDITIONS AT KUOPIO AERODROME
Ilona Soini 1970 40 p refs
(Rept-24) Avail: NTIS

Tabulated data covering the period 1 December 1957 to 30 November 1962 are presented for the Kuopio airport, Finland. Ceiling, visibility, surface wind, and weather information are grouped by various periods of the day and by various temperature and wind categories. Diurnal and seasonal distributions are included for wind direction and temperature. Precipitation and fog observations are also shown. J.M.

N71-20342# Sandia Corp., Albuquerque, N.Mex.
RESULTS OF AN INVESTIGATION INTO THE SPATIAL TEMPORAL VARIABILITY OF CLOUDINESS ON THE EUROPEAN TERRITORY OF THE USSR
D. M. Sonechkin et al 1970 21 p refs Transl. into ENGLISH from Gidromet. Nauch. Issled. Tsent. SSSR (USSR), no. 50, 1969 p 37–46 Sponsored by AEC
(SC-T-70-4040) Avail: NTIS

Meterological satellite data on cloud cover is combined with ground observations, and temporal and spatial correlation functions are calculated. The method of calculation, errors, and accuracy of the correlation functions are discussed. N.E.N.

N71-20398*# Wyoming Univ., Laramie. Dept. of Physics.
AN AIRCRAFT BORNE DUST PARTICLE COUNTER AND ITS APPLICATIONS TO THE STUDY OF CLEAR AIR TURBULENCE
James M. Rosen and Robert A. Sadler [1970] 16 p refs
(Contract NAS1-9592)
(NASA-CR-111864) Avail: NTIS CSCL 04B

The instrumentation required for the detailed mapping of aerosol concentration in a region of clear air turbulence is described. The stages presented are the initial development of an airborne aerosol detector, environmental testing, and field testing. The results indicate that a qualitative measurement of atmospheric aerosols can be made by an airborne particle counter. F.O.S.

N71-20486# France. Direction de la Meteorologie Nationale, Paris.
PRECIPITATION MEASUREMENTS [LA MESURE DE PRECIPITATIONS]
C. Harrang Nov. 1970 90 p refs In FRENCH
(Rept-78) Avail: NTIS

Various precipitation gages and rain measuring methods are discussed. Emphasis is placed on instrument accuracy, qualitative and quantitative properties, and sensitivity to atmospheric moisture content. Transl. by G.G.

N71-20487# France. Direction de la Meteorologie Nationale, Paris.
THE MISTRAL IN THE WESTERN PROVENCE [LE MISTRAL EN PROVENCE OCCIDENTALE]
F. Boyer, A. Orieux, and E. Pouget Dec. 1970 30 p refs In FRENCH
(Rept-79) Avail: NTIS

Climatological characteristics of the north-eastern wind of the Provence, the mistral, are reported. Favorable aspects for mistral formation, its regional dimensions, various statistics of its duration and intensity, and its periodicity are discussed. Transl. by G.G.

N71-20553 Meteorological Office (Gt. Brit.)
THE BUSHBY-TIMPSON 10-LEVEL MODEL ON A FINE MESH
G. R. R. Benwell, A. J. Gadd, J. F. Keers, Margaret S. Timpson, and P. W. White London HMSO 1971 64 p refs *Its* Scientific Paper No. 32
(MET-O-836) Copyright. Avail: HMSO 11s (55 1/2 d); BIS $2.20

A full description is given of the 10-level numerical model which was developed as a basis for computations in investigating the dynamics of fronts and in predicting frontal rainfall. The formulation now incorporates the effects of surface friction, topography, heat and moisture transfers across the bottom boundary, sub-grid-scale convection, and lateral diffusion. Furthermore, the restriction that the initial wind fields should be nondivergent was removed and vertical motions are present initially. However, no ice stage is yet incorporated in the condensation physics. The development of the model up to the end of 1969 is described, and an example of a recent forecast is included. Author

N71-20567# Finnish Meteorological Office, Helsinki.
AERONAUTICAL CLIMATOLOGICAL CONDITIONS AT KAJAANI AERODROME
Ilona Soini 1970 38 p
(Rept-21) Avail: NTIS

Climatological tables of aeronautical meteorological conditions are presented based on observations made over the period 1 Jan. 1956–30 Nov. 1961. The tables are prepared in accordance with international regulations agreed on by the International Civil Aviation Organization and the World Meteorological Organization. The climatological summaries are reported in four main tables which include the following: (1) distributions of visibility and ceiling; (2) distributions of surface wind; (3) distributions of very bad, bad, and poor flight conditions according to wind direction and speed; and (4) distributions of temperatures at four observation times (00, 06, 12, and 18 GMT). In addition to the main tables there are also tables giving distributions of dry bulb temperatures and hydrometers. Some of the distributions are presented in graphical form. D.L.G.

N71-20568# Finnish Meteorological Office, Helsinki.
AERONAUTICAL CLIMATOLOGICAL CONDITIONS AT KRUUNUNKYLA AERODROME

Ilona Soini 1970 40 p refs
(Rept-23) Avail: NTIS

Climatological tables of aeronautical meteorological conditions are presented based on observations made over the period 1 Dec. 1960 – 30 Nov. 1965. The tables are prepared in accordance with international regulations agreed on by the International Civil Aviation Organization and the World Meteorological Organization. The climatological summaries are reported in four main tables which include the following: (1) distributions of visibility and ceiling; (2) distributions of surface wind; (3) distributions of very bad, bad, and poor flight conditions according to wind direction and speed; and (4) distributions of temperatures at four observation times (00, 06, 12, and 18 GMT). In addition to the main tables there are also tables giving distributions of dry bulb temperatures and hydrometers. Some of the distributions are presented in graphical form. D.L.G.

N71-20583# Finnish Meteorological Office, Helsinki.
AERONAUTICAL CLIMATOLOGICAL CONDITIONS AT KEMI AERODROME
Ilona Soini 1970 40 p refs
(Rept-22) Avail: NTIS

Climatological tables of aeronautical meteorological conditions are based on the observations made over the period 1956 to 1961 at Kemi airport, Finland are presented. Observations, which are used in calculations, are made at the usual synoptic hours e.g. 00, 03, 06, 09, 12, 15, 18 and 21 GMT. Seasons used in various tables are taken as follows: Winter includes December, January, February. Spring includes March, April, May. Summer includes June, July, August. Autumn includes September, October, November. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N71-19463*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CRYOGENIC FUELS FOR AIRCRAFT
Jack B. Esger *In its* Aircraft Propulsion 1971 p 397-420 refs
(See N71-19451 09-28)
Avail: NTIS HC$6.00/MF$0.95 CSCL 21D

Exploratory research on the use of cryogenic fuels for airbreathing gas turbine engines is presented. The two prime reasons for the interest in cryogenic fuels for advanced aircraft are the higher heating value per pound of fuel and the heat sink capacity that is available in this fuel for cooling hot components in the engine or the aircraft. The possible applications of liquid methane to a supersonic transport type aircraft and the application of liquid hydrogen to the airbreathing engines for recoverable boosters and orbiters for the space shuttle are discussed. Author

N71-19848# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A COCKPIT SITUATION DISPLAY OF SELECTED NAS/ARTS DATA
Richard W. Bush, Howard Blatt, and Francis X. Brady 15 Dec. 1970 22 p
(Contract F19628-70-C-0230)
(AD-716425; TN-1970-39; ESD-TR-70-404) Avail: NTIS CSCL 17/7

By the mid-1970s, the evolving NAS/ARTS ground environment will provide the air traffic controllers with high quality computer-processed traffic situation displays. We believe it would be useful, particularly in busy terminal areas, to display some of this data in the cockpit. Systems with this objective have been constructed and flight tested at least 3 times during the past 25 years, but these earlier systems could not benefit from: a source of computer-processed data of the quality to be available from NAS/ARTS; aircraft altitude information; contemporary digital data link techniques; and airborne equipment capable of automatically selecting and displaying only information relevant to a particular airplane. It is believed that an effective cockpit display would permit pilots, under IFR conditions, to retain some of the station-keeping and navigation functions they perform during VFR conditions and thereby improve the efficiency of terminal area operation. The goals of the proposed program are: to evaluate the effectiveness of this class of system in reducing pilot and controller work loads, and to determine its potential for expediting traffic flow in busy terminal areas. A simulated cockpit display has been developed and experienced pilots and controllers who have flown it have endorsed enthusiastically the desirability of evaluating this class of system in an operational environment. Author (GRA)

N71-19902# California Univ., Los Angeles. School of Engineering and Applied Science.
THE CONJUGATE GRADIENT METHOD AND ITS APPLICATION TO AEROSPACE VEHICLE GUIDANCE AND CONTROL. PART 1: BASIC RESULTS IN THE CONJUGATE GRADIENT METHOD
Cornelius T. Leondes and C. A. Wu Nov. 1970 35 p refs
(Grant AF-AFOSR-0699-67)
(AD-716445; AFOSR-70-2774TR-Pt-1) Avail: NTIS CSCL 12/1

The effectiveness of the CG (Conjugate Gradient) method for the solution of the optimal aerospace vehicle guidance and control problem is demonstrated. The superiority of the convergence rate of the CG method over the steepest descent method is demonstrated. The search of golden section technique is also discussed and shown to be a very powerful technique for one dimensional optimization. As one dimensional search cannot be carried out exactly accumulation of errors due to this source can produce directions of search which increase rather than decrease the objective functional. In this case it is found useful to go back to the local gradient direction and start the process over again. A number of new basic theorems and algorithmic techniques fundamental to the CG method are presented here and the establishment of a monotonic decreasing sequence for the cost functional which results in the determination of the optimal control is shown. A companion paper applies the basic results developed in this paper to the Mars entry guidance and control problem. Author (GRA)

N71-20143*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EQUILIBRIUM STATES FOR A CLASS OF DUAL SPIN SPACECRAFT
Thomas W. Flatley (Ph.D. Thesis – Catholic Univ. of Am.) Washington Mar. 1971 94 p refs
(NASA-TR-R-362; G-1011) Avail: NTIS CSCL 17G

The attitude motion of a dual-spin spacecraft consisting primarily of two symmetric bodies with a common axis of rotation and a constant relative spin rate is analyzed. Each of the main bodies contains a spring mass dashpot damper with a degree of freedom parallel to their common axis. The equations of motion are studied by means of a perturbation analysis in which only the damper masses are assumed small. The problem then becomes the determination of perturbations to a reference motion similar to the general precession of the torque-free rigid body in classical mechanics. One of the key parameters associated with such motion is the nutation angle (or the angle between the nominal spin axis and the inertially-fixed angular momentum vector). By determining the zeroth and first order behavior of this angle for this system,

a general analytical stability criterion is established. This criterion not only determines the stability or instability of an arbitrary initial state of the system, but reveals the nature of any instability which might exist. Author

N71-20144*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A STATISTICAL STUDY OF ABILITY OF SIMULATED PILOTS TO CONTROL THE APPROACH AND DESCENT OF THE LUNAR MODULE TO THE LUNAR SURFACE

Jacob H. Lichtenstein Washington Mar. 1971 59 p refs

(NASA-TN-D-6113; L-7377) Avail: NTIS CSCL 17G

The ability of a pilot, simulated by permissible error performance, to control the entire lunar approach and descent with relatively simple guidance schemes was analyzed. The control task consisted of applying retrothrust during the hyperbolic approach to establish a lunar orbit. During this lunar coasting orbit, the lunar module was separated from the command and service module. A second deorbit thrust period was used on the lunar module to establish a coasting descent, and a final thrust period was used to put the vehicle into a reasonable landing situation. Throughout the maneuver the pilot was permitted to make reasonable errors, selected in a random manner, in the thrust time and attitude control. The results show that a relatively accurate pilot, one whose standard deviation of error is 0.1 sec and 0.1 deg or less, would be necessary to avoid excessively large errors. Even such a pilot would be required to switch to another form of terminal guidance to bring the flight conditions within acceptable values near touchdown. Correction coefficients were determined which permitted corrections to be applied to the second and third thrust periods for errors made in the previous thrust periods. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N71-19392# Los Alamos Scientific Lab., N.Mex.

STUDIES ON THE U-Pu-Zr ALLOY SYSTEM FOR FAST BREEDER REACTOR APPLICATIONS

D. R. Harbur, J. W. Anderson, and W. J. Maraman Aug. 1970 14 p refs

(Contract W-7405-eng-36)

(LA-4512) Avail: NTIS

Pure U–Pu–Zr alloys are prepared by conventional melting and casting techniques using NbC- or Y2O3-coated graphite crucibles. The centerline porosity and inverse segregation of zirconium in castings can be minimized by chill-casting. The as-cast material may be hot extruded. The extruded product, although brittle up to 280 C, is plastic above 450 C. The alloys are very hard at ambient temperatures (400 dph). The thermal conductivity ranged from 0.03 to 0.07 cal/sec-cm-C (at 110 and 892 C, respectively). For the same composition range the liquidus temperature increased from 1240 to 1425 C and the solidus increased from 1105 to 1195 C. Chemical homogenization is accomplished by heat treatment in the gamma phase (above 700 C). A thermal gradient (500 to 750 C) causes mass ion transport of zirconium. Anisotropic growth and density decrease result from repeated thermal cycles through the phase transformations. Author (NSA)

N71-19393# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.

QUANTITATIVE DETERMINATION OF THE STRUCTURE: PROPERTY RELATIONSHIPS IN NUCLEAR FUEL ELEMENT MATERIALS Annual Progress Report, 15 Jun. 1969–14 Jun. 1970

F. N. Rhines, R. T. DeHoff, and L. L. Hench Sep. 1970 58 p refs

(Contract AT(38-1)-552)

(SRO-552-4) Avail: NTIS

Research directed toward the establishment of quantitative relationships between microstructure and properties in nuclear fuel element materials is reported. The materials and equipment necessary for carrying out this program have been assembled, including an image analyzing computer, thermal conductivity device, gas permeability apparatus, and creep furnaces. Selected sinterings from the two powders have been prepared and tested in these devices, and all have been demonstrated to be operational. Gas premeability of nickel sinterings has been found to depend upon porosity in proportion to the genus (or connectivity) of the pore network. Preliminary information on the dependence of this relationship upon particle size indicates that the genus is not the only geometric factor involved in governing gas permeability. Studies in the quantitative microscopy of fractures have yielded a new relationship which permits the estimation of the area fraction of solid phase in a fracture surface. Author (NSA)

N71-19411# California Univ., Livermore. Lawrence Radiation Lab.

HEAT PIPES FOR RECOVERY OF TRITIUM IN THERMONUCLEAR REACTOR BLANKETS

R. W. Werner 18 Mar. 1970 7 p refs Presented at 5th Ann. Intersoc. Energy Conversion Eng. Conf., Las Vegas, Nev., 21-25 Sep. 1970 Sponsored by AEC

(UCRL-72329; CONF-700912-9) Avail: NTIS

Controlled thermonuclear reactors, using deuterium–tritium as a fuel for the fusion reaction, require a means of regenerating tritium so that cycle continuity is maintained. A unique way for statisfying the tritium needs is suggested. It is proposed that heat pipes using sodium as a working fluid be used in tritium transporters in the blanket structure of a fusion reactor. The tritium produced by the reactions in the lithium moderator of the blanket would be diffused through the heat-pipe tube wall and transported within the heat-pipe body and then processed for recycling. Heat pipes are explained as heat-transfer devices and as gas handlers in a fusion reactor environment. Author (NSA)

N71-19477# Oak Ridge National Lab., Tenn.

HEAVY SECTION STEEL TECHNOLOGY PROGRAM

G. D. Whitman and F. J. Witt Nov. 1970 30 p refs Presented at Symp. on the Technol. of Pressure-Retaining Steel Components, Vail Village, Colo., 21–23 Sep. 1970

(Contract W-7405-eng-26)

(ORNL-TM-3055; CONF-700935-1) Avail: NTIS

The heavy section steel technology program is an engineering investigation aimed at assessing the structural safety of primary pressure vessels for water-cooled nuclear reactor electric power plants. The main emphasis is placed on the effects of flaws, material inhomogeneities, and discontinuities on the behavior of the vessels under normal operation and accident conditions. The overall program is briefly summarized, and the more pertinent data are discussed. Fracture phenomena under the environmental conditions of interest and the effects of section thickness on the fracture behavior of large reactor vessels are being examined by a systematic progression of specimens up to the equivalent of full section thicknesses of 12 in. Plans have been made to test vessels of substantial thickness to failure in order to verify the adequacy of methods developed to predict fracture behavior. Author (NSA)

N71-19478# WADCO Corp., Richland, Wash.
ASPECTS OF DENSITY MANIPULATION IN FABRICATION OF MIXED (U, Pu) OXIDE FUEL PELLETS
M. J. Barr Oct. 1970 50 p refs
(Contract AT(45-1)-2170)
(WHAN-FR-7) Avail: NTIS

Density control in mixed oxide ((U,Pu)02) fuel pellets can be achieved by several ceramic processing techniques. Binder-lubricant (hydrocarbon) additions, calcination of blended oxides, and ball-milling parameters were evaluated with respect to degree of density change and modification of microstructure. Binder-lubricants evaluated included Carbowax, Sterotex, methyl cellulose, polyvinyl alcohol, and Acrawax. Calination of blended oxides was done in air and in nitrogen at temperatures up to 1000 C. Mixing-grinding experiments evaluated the effect of time, techniques, and grinding media on density, homogeneity, and impurity level.
Author (NSA)

N71-19497*# General Electric Co., Cincinnati, Ohio. Space Div.
SNAP-8 REFRACTORY BOILER DEVELOPMENT. TOPICAL REPORT 3: EVALUATION OF SNAP-8, SN-1 BOILER
W. H. Henderixson and R. W. Harrison 3 Nov. 1970 55 p refs
(Contract NAS3-10610)
(NASA-CR-72814; GESP-550) Avail: NTIS CSCL 18N

The SNAP-8, SN-1 boiler which was designed and fabricated by NASA was performance tested for 13,500 hours. After testing the boiler was removed from the test facility and the boiler materials were evaluated. The evaluation indicated excellent compatibility of the boiler materials with liquid metals at high temperatures and all indications point to the design life capability of 40,000 hours.
Author

N71-19675*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A PRELIMINARY SHIELD DESIGN FOR A SNAP-8 POWER SYSTEM
I. M. Karp, L. Soffer, and M. R. Clark [1971] 6 p refs Presented at the Natl. Symp. on Nat. and Manmade Radiation in Space, Las Vegas, Nev., 1 – 5 Mar. 1971; sponsored by AEC and NASA
(NASA-TM-X-52978; E-6187) Avail: NTIS CSCL 18N

A preliminary shield design for a nuclear power system utilizing a SNAP-8 reactor for space base application is presented. A representative space base configuration was selected to set the geometry constraints imposed on the design. The base utilizes two independent power packages each with a reactor operating at 600 kWt and each producing about 50 kWe. The crew compartment is located about 200 feet from each reactor and is large enough in extent to intercept a total shadow angle of 60 deg measured about the center line of each reactor. Reactor dose constraints for the shield design were: (1) the dose to the crew over a 6 month mission was set at 150 mrem/day, (2) the dose along the side of either power system was set at 30 mrem/hr at a distance of 200 feet, based on considerations of exposure during repair to one power system while the other is operating, and (3) the dose constraint elsewhere around the reactor was set at 5 rem/hr at a distance of 200 feet. The weight of the idealized layered lithium hydride and depleted uranium shield layout used as the calculational model was about 35,000 pounds whereas the preliminary engineering layout of the shield which includes structure, canning materials, clearance gaps between layers, etc. weighed about 41,000 pounds.
Author

N71-19723# Army Engineer Reactors Group, Fort Belvoir, Va. Engineering Div.
SM-1A CORE 4 LOADING AND STARTUP CORE PHYSICS TEST REPORT Final Report
Charles D. Henry, III 15 Nov. 1970 110 p refs
(AD-716609; ED-7009) Avail: NTIS CSCL 18/11

The report discusses the nuclear behavior of the SM-1A reactor during refueling with core 4, and the conduct and results of the startup core physics tests on core 4. The report presents and analyzes the data recorded. The core physics tests results are used to check the actual behavior of the core and compare it to the predicted behavior. Various figures and tables are used to illustrate the measured results.
Author (GRA)

N71-19814# Naval Research Lab., Washington, D.C.
IRRADIATION EFFECTS ON REACTOR STRUCTURAL MATERIALS Quarterly Progress Report, 1 Aug. – 31 Oct. 1970
L. E. Steele, C. Z. Serpan, Jr., F. J. Loss, J. R. Hawthorne, and P. P. Puzak 15 Nov. 1970 61 p refs
(Contract AT(49-5)-2110)
(AD-716405; NRL-MR-2181) Avail: NTIS CSCL 18/10

The report, covering research for the period 1 August - 31 October 1970, includes: (1) initial radiation damage surveillance results for the MH-1A reactor vessel, (2) development of a reference fluence decrease through a reactor vessel wall, (3) analysis of the fluence gradient in terms in terms of fracture behavior, including fracture extension resistance for the through-wall vessel properties, (4) correlation of Charpy-V and dynamic tear test results for reactor steels after irradiation, (5) true stress-natural strain determinations for saveral high temperature alloys irradiated in the EBR-II reactor, and (6) the nature of dislocation loop growth during annealing of irradiated vanadium.
Author (GRA)

N71-19863# Naval Intelligence Command, Alexandria, Va. Translation Div.
VENTILATION DEVICES FOR WORK WITH RADIOACTIVE SUBSTANCES [VENTILYATSIONNYYE USTROYSTVA DLYA RABOTY C RADIOAKTIVNYKH VESHCHESTV]
V. M. Krupchatnikov 18 Dec. 1970 34 p Transl. into ENGLISH from the publ. 'Atomizdat' Moscow, Nauka Press, p 60 – 74 and 195 – 217
(AD-716265; NIC-Trans-3151) Avail: NTIS CSCL 13/1

Contents: Ventilation for radioactive substances in storage; Ventilation for nuclear reactor installations; Ventilation for accelerator rooms; Stacks for discharging ventilation air; General plan and good organization of the territory of an enterprise; Organization of production processes for protecting atmospheric air.
GRA

N71-19893# Gulf General Atomic, San Diego, Calif.
USE OF LOW ENRICHMENT URANIUM IN THE HTGR
B. W. Southworth, D. H. Lee, Jr., and R. C. Dahlberg 30 Sep. 1970 79 p refs
(Contract AT(04-3)-167)
(GA-9715) Avail: NTIS

The study of low enrichment fuel cycle is divided into three phases in which fuel elements of different geometry are used to reduce the resonance integral of U-238 and thereby the enrichment requirements. The first phase concerns the original fuel element design for the Fort St. Vrain Power Reactor. The second phase pertains to a modified Fort St. Vrain Power Reactor fuel element. The third phase relates to an extensively modified fuel element. Economics for annual and semiannual refueling are compared.
NSA

N71-19897# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
PARTICLE SIZE DISTRIBUTIONS FROM FUEL RODS FRAGMENTED DURING POWER BURST TESTS IN THE CAPSULE DRIVER CORE
J. A. McClure Oct. 1970 115 p refs
(Contract AT(10-1)-1230)
(IN-1428) Avail: NTIS

Particle distributions obtained from individual fuel rods fragmented during rapid power bursts in the capsule driver core are shown to follow a log-normal frequency distribution in weight percent versus the particle size. The parameters for each distribution are given and their correlation with energy deposition in the fuel and with rod design is examined. Evidence is given to show that the distributions do not shift indefinitely toward smaller particle sizes with increasing energy density but approach an asymptotic distribution. The fuel rod design influences the particle distributions near the fragmentation threshold. Author (NSA)

N71-19898# Argonne National Lab., Ill.
SYMPTOMS AND DETECTION OF A FISSION-PRODUCT RELEASE FROM EBR-2 FUEL ELEMENT. CASE 2: DEFECT BELOW FUEL ELEVATION. EBR-2 PROJECT
R. M. Fryer, R. R. Smith, E. R. Ebersole, and R. V. Strain Jun. 1970 38 p refs
(Contract W-31-109-eng-38)
(ANL-7676) Avail: NTIS

Experience in EBR-2 with a fuel element having a defect at the lower end brought an increased ability to identify the type of defect by interpreting the response from fission-product monitors. The defect covered became apparent when, during a reactor shutdown on December 24, 1968, a fission-product release occurred after pump shutdown. The source of leakage (subassembly C2008) was identified by correlating the timing of subsequent releases with routine changes in core loading. Before the identification was made, analysis had shown that the source must be a driver-fuel element with a defect near the lower end. This conclusion was confirmed by postirradiation examination. The fingerprint of this particular type of leaker is easily distinguishable from that of releases through flaws at other elevations along a fuel element. Author (NSA)

N71-19899# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
FEASIBILITY STUDY OF AN AUTO-RADIOGRAPHIC TECHNIQUE FOR THE DETERMINATION OF RELATIVE POWER DENSITIES IN REACTOR FUEL PLATES
D. W. Magnuson 20 Nov. 1970 33 p
(Contract W-7405-eng-26)
(Y-DR-29) Avail: NTIS

Autoradiography is shown to be a feasible method for determining fission density distributions in the fuel plates of reactors. Because the U was not uniformly distributed between the cladding of the fuel plates, the film response varied for autoradiographs made from opposite sides of an irradiated fuel plate. However, it was found that the average film response was independent of the U distribution and a single calibration was found to be adequate for U loadings which varied from 6.9 to 17.3 mg of U-235 per sq cm. Author (NSA)

N71-19900*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
HIGH SPECIFIC IMPULSE GAS-CORE REACTORS
Robert G. Ragsdale Washington Mar. 1971 19 p refs
(NASA-TM-X-2243; E-6087) Avail: NTIS CSCL 18N

Calculations are carried out to estimate gas-core nuclear rocket engine weights for specific impulses ranging from 3000 to 7000 seconds, and for engine thrusts ranging from 4400 to 440,000 newtons. Engine weight was found to vary from 35,000 to 270,000 kilograms, for the entire range of specific impulses and thrust levels of this study. This engine weight range corresponds to a specific mass that varies from 0.6 to 0.02 kilogram of weight per kilowatt of thrust power. Author

N71-19903# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report, Oct. 1970
24 Nov. 1970 171 p refs
(Contract W-31-109-eng-38)
(ANL-7753) Avail: NTIS

LMFBR physics development and component development are reviewed. Operations and analysis of ZPR-3, ZPR-6, ZPR-9, and ZPPR are described. The EBR-2 research and development projects, fuel development, and operations are summarized. Reactor fuels and materials development, physics studies, engineering development, fuel cycle chemistry, and LMFBR safety studies are reported. NSA

N71-19904# Argonne National Lab., Ill.
EBR-2 CODES FOR PROCESSING REACTIVITY DATA AT FULL AND REDUCED COOLANT FLOWS. EBR-2 PROJECT
J. K. Long and E. M. Dean May 1970 45 p refs
(Contract W-31-109-eng-38)
(ANL-EBR-20) Avail: NTIS

Comparing measurements of power reactivity decrements (PRD) at full and reduced coolant flows requires that corrections be applied for thermal expansion of back of control rod handles, bulk sodium temperature, fuel burnup, flow variations, control rod calibrations, and several instrument calibrations. Computerized methods for calculating these corrections in a uniform and orderly manner were developed. The sequence of calculations is: determination of control rod worths; determination of rod bank position; correction for effects of thermal expansion of control rod and PRD for a control rod configuration; and determination of an effective thermal expansion parameter of fuel from data for reduced coolant flows. This parameter is an effective average expansion coefficient for dirver and experimental fuels in the cord. Author (NSA)

N71-19928# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS ON DEVELOPMENT OF FUELS AND TECHNOLOGY FOR ADVANCED REACTORS Annual Report, Jul. 1969–Jun. 1970
Donald L. Keller Jul. 1970 252 p refs
(Contract W-7405-eng-92)
(BMI-1886) Avail: NTIS

Research and development progress is reported on design and operation of in-pile creep capsules, mechanical and thermal analyses of oxide fuels, fabrication of fuel creep specimens, compressive creep testing of fuels, and mechanisms of creep in oxide fuels. Radiation effects testing of oxide fuels, W-UO2 cermets, nitride fuels, and carbide fuels are summarized. Results of work are also included on fission gas diffusion, fission gas bubble characteristics, creep of fuels and cladding materials, fuel sublimation, solid bonding, transducer development, and neutron radiography. Thermodynamic properties of PuN and UN are presented as well as results of work on the compatibility of PuN and UN with cladding and coolants, analyses of Na capsule bonds, diffusion in nitrides, Na bonding of nitride fuels, fabrication of PuN–UN fuels, radiation effects on nitride fuels, preparation of EBR-2 fuels, TREAT testing, and physics support for nitride fuels program. NSA

N71-19938# Atomic Energy Commission Research Establishment, Riso (Denmark). Metallurgy Dept.
[NUCLEAR AND GENERAL MATERIALS RESEARCH AND TECHNOLOGY] Annual Progress Report, Period Ending 31 Mar. 1970
Jun. 1970 40 p refs
(RISO-225) Avail: AEC Depository Libraries

The Danish fuel element is mainly concerned with uranium-dioxide/Zircaloy fuel elements for water-cooled power reactors. The maximum burn-up achieved so far in a BWR is 11,600 MWd/t. In the the DR 3 test fuel pins are irradiated under more severe conditions and to higher burn-ups (target: 40,000 MWd/t.) These tests also include fuel/cladding interaction studies and evaluation of manufacturing parameters. Long term programs on

zirconium-cladding development include corrosion testing of advanced zirconium alloys. A program on dispersion-strengthened zirconium alloys resulted in materials with a satisfactory corrosion resistance and a creep strength considerably improved compared with that of Zircaloy-2. Preparation of improved uranium-dioxide powder for pellet fabrication was studied by variation of the precipitation parameters for ammonium-duranate. An extensive program on pressure-vessel steel development comprising neutron irradiation and subsequent mechanical testing was carried out. NSA

N71-19937# Gulf General Atomic, San Diego, Calif.
HTGR BASE PROGRAM Quarterly Progress Report, Period Ending 31 Aug. 1970
30 Sep. 1970 57 p refs
(Contract AT(04-3)-167)
(GA-10288) Avail: NTIS

Preliminary design and development of a 1000 MW(e), gas cooled, nuclear power reactor are summarized. Diffusion of cesium-134; cesium-137, and strontium in graphite was investigeged as well as strontium vaporization from fuel element graphite and neutron radiation effects on the dimensional stability of graphite. Physics parameters of HTGR lattices are outlined for a high temperature lattice test reactor. Test element design and fabrication are reported including the development of a reprocessing cycle for gas-cooled reactor fuel elements. A code and mathematical model for the description of fission product transport in a HTGR are included. Plant designs and reprocessing costs are also given. J.M.

N71-19974# Argonne National Lab., Ill.
AN EXPERIMENTAL STUDY OF LOW QUALITY, STEAM WATER CRITICAL FLOW AT MODERATE PRESSURES
Robert E. Henry Sep. 1970 23 p refs
(Contract W-31-109-eng-38)
(ANL-7740) Avail: NTIS

Data for two-phase, steam-water critical flow were obtained in a long, constant-area duct. The ranges of parameters studied were flow rates from 1649 to 6603 lb sub m/sec-sq ft, exit pressures from 150 to 300 psia, and thermodynamic-equilibrium qualities from 0.0030 to 0.1467. The data exhibit the same general trends as previously published low-pressure (40 to 150 psia) experimental results, and they are also in good agreement with a correlation derived from the low-pressure data. Author (NSA)

N71-19981# Argonne National Lab., Ill.
EXPERIMENTS WITH A SERIES OF SMALL, Pu-PLUS-U FUELED FAST REACTOR CRITICALS (FARET MOCKUP ZPR-3 ASSEMBLY 46)
Allen L. Hess, William P. Keeney, and Robert L. McVean Jan. 1970 97 p refs
(Contract W-31-109-ENG-38)
(ANL-7215) Avail: NTIS

ZPR-3 Assembly 46 was a series of small Pu-plus-U-fueled fast reactor cores studied in conjunction with design efforts for FARET, a conceptual fast-fuels test reactor. Six different cores, labeled A through F, were constructed as mockups of possible FARET loadings. Cores A and B simulated PuC–UC-fueled cores with volumes of 57 and 68 liters, respectively. Core C was an 87 liter system with a PuO2–UO2 fuel representation. Cores D, E, and F, with volumes of 80, 108, and 95 liters, respectively, were each composed of four annular fuel zones. The different zones contained simulations of oxide, carbide, and alloy fuels as mockups of envisaged multifueled FARET cores. An additional three-zoned core, Core G, was used for fast-reactor physics experiments of a general nature. Principal experiments with the mockups were: evaluating the reactivity control afforded by FARET-design B4C control rods, measuring worths of fuel interchanges, obtaining flux distributions, and measuring reactivity coefficients for core-constituent materials. Author (NSA)

N71-19982# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
PHYSICS VERIFICATION PROGRAM, PART 3, TASK 4 Quarterly Technical Report, Jul. – Sep. 1970
M. N. Baldwin Dec. 1970 16 p refs
(Contract AT(30-1)-3647)
(BAW-3647-19-PT-3) Avail: NTIS

Unclad Pyrex glass rods, aluminum-clad Vicor glass rods, aluminum-clad Al2O3 rods, and water holes were spaced on selected patterns in an otherwise uniform clean lattice in the CX-10 facility. Their effects on the core midplane power shape are presented. NSA

N71-20008# Atomics International, Canoga Park, Calif.
LMFBR SAFETY PROGRAMS Quarterly Technical Progress Report, Jul. – Sep. 1970
12 Nov. 1970 39 p refs
(Contract AT(04-3)-701)
(AI-AEC-12979) Avail: NTIS

Coolant combustion accidents in liquid metal fast breeder reactors (LMFBR) are discussed including the release and transport of aerosols and energy from sodium coolants. The effects of sodium coolant boiling on LMFBR kinetics and the initiation and thermal hydraulics of sodium are described. NSA

N71-20031# Arizona Univ., Tucson. Dept. of Nuclear Engineering.
STABILITY OF NUCLEAR REACTOR SYSTEMS HAVING TIME DELAYS
Kenneth Dermot Kearns (Ph.D. Thesis) Jun. 1971 117 p refs
(Contract AT(04-3)-670)
(COO-2109-2) Avail: NTIS

A technique based on the Mikhailov stability criterion has been developed to study the effects of time delays on the stability of linear systems. Specifically, the technique utilizes Descartes' rule of signs and Sturm's theorem to determine regions within the system parameter space in which stability or instability is conditional on the value of the time delay. In these regions, the critical time delay indicating the stability boundary may also be determined. The method is applied to a seventh-order, in-core thermionic reactor model containing two coolant time delays between the radiator and the core. Stability is found to depend on the sum of the two delays. The results of the analysis reveal the existence of conditional instabilities within physically possible operating regions of the parameter space. Within the conditionally stable regions, several critical time delays are calculated to indicate how stability depends on the value of the time delay. Author (NSA)

N71-20033# Idaho Nuclear Corp., Idaho Falls.
SEMISCALE BLOWDOWN AND EMERGENCY CORE COOLING (ECC) PROJECT TEST REPORT: TESTS S03 THROUGH S20
H. W. Heiselmann, D. J. Olson, and J. F. Whitbeck Oct. 1970 183 p refs
(Contract AT(10-1)-1230)
(IN-1404) Avail: NTIS

A portion of the results of the semiscale blowdown and emergency core cooling project tests is reported. The purpose of the semiscale blowdown and emergency core cooling project is to provide the experimental data base required for development and assessment of analytical models for predicting the thermal hydraulic behavior occurring in a large PWR during a loss-of-coolant accident. The results reported were obtained from decompression experiments on a circulating loop connected to a simulated reactor vessel (without internals) that constitute an extension of previous decompression tests with only a vessel. All tests were initiated from isothermal fluid conditions. Pressure, temperature, strain, momentum, flux, thrust, and limited flow and density information are reported for various break sizes, configurations, and initial conditions. The amount of water remaining, blowdown time, and indications of the thermodynamic processes are also reported. Author (NSA)

N71-20071# Bettis Atomic Power Lab., Pittsburgh, Pa.
NEW STATIC FLUX SYNTHESIS MODEL FOR MOVABLE MATERIAL REACTOR PROBLEMS (LWBR DEVELOPMENT REPORT)
J. B. Yasinsky and L. R. Foulke Nov. 1970 33 p refs
(Contract AT(11-1)GEN-14)
(WAPD-TM-978) Avail: NTIS

An approach to spatial synthesis is developed with emphasis on the dependence of the flux between axial solution points. The standard synthesis approach (as well as all spatial differencing methods used for neutron diffusion problems) assumes that the flux is a piecewise constant function of z. That is, the flux is constant over some axial region about each axial solution point. It is shown that the standard approach leads to nonphysical results for problems where material interfaces (such as control rod interfaces or movable zoned fuel region interfaces) are moved so that they fall between axial solution points. New synthesis methods, based on the use of continuous piecewise polynomials to represent the z dependence of the flux, are shown to result in improved solutions for such movable material problems. This new approach permits material interfaces to fall on or between mesh points. There is no requirement that material interfaces line up with solution points. Author

N71-20112# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Reaktorbauelemente.
SUPERHEATED STEAM FILTER, PART 1 [HEISSDAMPFFILTER, TEIL 1]
H. John May 1970 59 p refs In GERMAN
(KFK-1183) Avail: AEC Depository Libraries

The filtration of superheated steam is very important in a steam cooled nuclear reactor, because any solids carried along from the reactor constitute a great contamination hazard to the entire steam circuit. Since practically no such filters have been known before, a number of materials which appeared to be suitable were experimentally investigated for their applicability. The results of these experiments are presented. Author (NSA)

N71-20142*# Humphreys Corp., Concord, N.H. Tafa Div.
CURVED PERMEABLE WALL INDUCTION TORCH TESTS
Charles E. Vogel Washington NASA Mar. 1971 47 p refs
(Contract NAS3-13226)
(NASA-CR-1764) Avail: NTIS CSCL 18L

An experimental program was conducted with permeable walls and solid-rod feed techniques to simulate these design features of the gas core nuclear rocket. A refractory oxide and sodium were chosen as the referenced materials for the permeable wall and solid-feed, respectively. An induction coupled arc plasma consisting of vaporized sodium was successfully sustained inside of a permeable wall through which nitrogen was being introduced. Wall gas mass flows of from 1,500 to 5,000 times that of the solid-feed material were achieved. Mixing profiles of gas flow indicated that no recirculation was experienced during plasma operation. Author

N71-20145# Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule.
DECONTAMINATION OF IRRADIATED-FUEL PROCESSING WASTE USING MANGANESE DIOXIDE HYDRATE [DECONTAMINATION DES EFFLUENTS DE TRAITEMENT DES COMBUSTIBLES IRRADIES PAR LE BIOXYDE DE MANGANESE HYDRATE]
Jacqueline-Marguerite Auchapt and Jean-Francois Gaudier Jun. 1969 33 p refs In FRENCH
(CEA-R-3821) Avail: AEC Depository Libraries

The manganese dioxide process is designed to replace the calcium carbonate treatment for low and medium activity wastes. The objective was diminution of the volume of the sludge without decreasing the decontamination factor of the wastes. The process involves two additions of over 100 ppM of Mn(2+) to waste previously made basic and oxidizing; the precipitate formed in situ is separated after each addition. The process has the advantage of increasing the decontamination of strontium. The treatment can be used in a plant including two decantation units and has given effective results when applied in such a plant. Author (NSA)

N71-20147# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
PILOT PRODUCTION OF 325 kg OF URANIUM CARBIDE [FABRICATION PILOTE DE 325 KG DE CARBURE D'URANIUM]
Christian Clozet, Jacques Dessus, Jacques Devillard, Michel Guibert, and Guy Morlot Apr. 1969 43 p In FRENCH
(CEA-R-3745) Avail: AEC Depository Libraries

The pilot fabrication of uranium carbide rods to be mounted in bundles and assayed in two channels of the EL 4 reactor is described. The fabrication process includes production of uranium carbide granules by carbothermic reduction of uranium dioxide; electron bombardment melting and continuous casting of the granules; machining of the raw ingots into rods of the required dimensions; and assembling the rods to make the fuel elements. Both qualitative and quantitative results of this pilot production chain are discussed. Author (NSA)

N71-20153# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etides Nucleaires.
CONTACT EFFECTS BETWEEN MOLTEN UO2 AND SODIUM AND MOLTEN UO2 AND WATER
M. Amblard et al 3 Mar. 1970 61 p refs Transl. into ENGLISH of CEA, Grenoble, France, TT-96 Sponsored by US-EURATOM Fast Reactor Exchange Program
(EURFNR-811; TT-96) Avail: NTIS

Bringing molten UO2 into contact with sodium at 200 and 400 C revealed a very fine UO2 dispersion and considerable dynamic overpressure in the sodium. UO2-water contact (temperature 20 C and atmospheric pressure) led to the formation of long hollow tubes of UO2. In both the above cases, hollow drops of UO2 which trap the coolant are formed. The different properties of the two coolants, in particular the heat conductivity, heat capacity and boiling temperature, lead to a violent burst in the case of the sodium and to plastic deformation of the fuel in the case of the water. Fusion manipulation of a cylinder of UO2 by the Joule effect, surrounded by stainless steel cladding cooled by hot static water under pressure, showed that the clad was pierced by the molten UO2 and the fuel was able to disperse in the coolant. Author (NSA)

N71-20154# Atomic Energy Establishment, Winfrith (England).
ANALYSIS OF HEAVY WATER MODERATED CLUSTER LATTICES USING THE WIMS CODE
P. B. Kemshell May 1969 29 p refs
(AEEW-R-549) Avail: AEC Depository Libraries

A survey of a comprehensive series of measurements in the Canadian ZED-2 reactor has been used to study the ability of the lattice cell code WIMS to predict the neutron physics of heavy water moderated rod clusters. The calculational methods and data options used were identical with those used in a previous study of the extensive series of simulated SGHW lattices at AEE, Winfrith, and the comparisons between theory and experiments for the two systems are generally consistent. Certain discrepancies between calculated and measured cluster averaged reaction rates are noted but the spatial distribution of reaction rates is well predicted by WIMS. The Canadian lattices cover a wide range of cluster geometry, coolant type and lattice pitch, and when allowance is made for end-fittings, the predicted eigenvalues are encouragingly consistent. Author (NSA)

N71-20177# Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule.
INSTALLATION OF A BITUMEN COATING PLANT FOR HIGH ACTIVITY CONCENTRATES [INSTALLATION PILOTE D'ENROBAGE PAR LE BITUME DE CONCENTRATS DE HAUTE ACTIVITE]
Jean Rodier, Guy Lefillatre, and Philippe Seyfried Apr. 1969 22 p refs In FRENCH
(CEA-R-3734) Avail: AEC Depository Libraries

With excellent results obtained on the industrial coating of radioactive sludges, the possibility of solidifying the evaporation concentrates with bitumen was considered. For high activity concentrates, the use of bitumen is limited by temperature and radiation resistance. By making use of the characteristics of a blown bitumen, it was possible to design a high activity coating pilot plant treating concentrations of several tens of curies per liter. The plant will make use of a screw-type extrusion machine capable of coating treated concentrates at a rate of 20 1/hr. Before being coated, the concentrates will be subjected to a coprecipitation treatment designed to make the radioelements insoluble. The installation will make possible laboratory experiments on the coated material (measurements on self-heating, on electrical charges, on radiolytic gases, and also lixiviation tests). On the basis of available data, it is possible to coat concentrates having an activity of 20 Ci/1 at a price of 1840 francs per cubic meter. Author (NSA)

N71-20208*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SIMULATION OF RADIATION FROM RTG POWER SOURCES
Phillip A. Newman, Jr. *In* NBS Space Simulation Oct. 1970 p 129–140 refs (See N71-20201 09-11)
(NASA-TM-X-66937) Avail: NTIS; SOD $5.25 CSCL 18M

A radiation source (Pu(239)-Be) was selected to simulate, for the most part, the neutron effects of the RTG. Preliminary experiments with this source have indicated that for most electronic applications the neutron contributions of the RTG over a five year mission in present spacecraft configurations will not be a major problem. An analysis of the data from several experiments indicate that predictions of the radiation effects can be made for hotter configurations with a reasonable degree of confidence. Author

N71-20295*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STATUS OF OPEN-CYCLE GAS-CORE REACTOR PROJECT THROUGH 1970
Robert G. Ragsdale Washington Mar. 1971 23 p refs
(NASA-TM-X-2259; E-5608) Avail: NTIS CSCL 18L

Some recent gas-core reactor research experiments are reviewed, and engine performance characteristics are estimated using these latest results. Flow experiments using air/air indicate the uranium consumption might be less than 1 percent of the hydrogen propellant requirement. Specific impulses as high as 7000 seconds may be possible at rocket vehicle accelerations of 0.01. Additional work is required to more realistically simulate engine conditions in laboratory experiments. Author

N71-20313# United Kingdom Atomic Energy Authority, Culham (England).
RADIATION DAMAGE EFFECTS IN THE CONTAINMENT VESSEL OF A THERMONUCLEAR REACTOR
D. G. Martin Mar. 1970 69 p refs
(CLM-R-103) Avail: AEC Depository Libraries; HMSO 8s; BIS $1.60

During the lifetime of a thermonuclear reactor the containment vessel, assumed here to be fabricated from niobium, will be irradiated. This will result in high concentrations of transmutation products and an appreciable number of displacements of the atoms. A detailed discussion is given of the physical property changes due to this radiation damage for irradiation temperatures in the range 600 to 1200 C. Helium is expected to be the most serious transmutation product since it can aggregate into comparatively immoble bubbles and so produce swelling of the containment vessel. Assuming bubbles are maintained in equilibrium, it is shown that swelling under conditions anticipated in the reactor should not be too excessive for irradiation temperatures up to about 1000 C; also that below this temperature, fracture under tensile stress due to the growth of bubbles is not expected in practice. Author (NSA)

N71-20387# Commissariat a l'Energie Atomique, Chusclan (France). Centre de Production de Plutonium de Marcoule.
IRRADIATION TESTS ON BITUMEN AND BITUMEN COATED MATERIALS [ESSAIS D'IRRADIATION DE BITUME ET D'ENROBES BITUMINEUX]
Renee Tabardel-Brian, Jean Rodier, and Guy Lefillatre Apr. 1969 30 p refs In FRENCH
(CEA-R-3730) Avail: AEC Depository Libraries

The use of bitumen as a material for coating high-activity products calls for prior study of the resistance of bitumen to irradiation. The methods of preparation of bitumen-coated products are summarized and the equipment which was used for carrying out the beta and gamma irradiations of these products is listed. Analytical results obtained as a function of the dose rates chosen and of the total integrated dose are given. Conclusions are drawn concerning the best types of bitumen. Some bitumens underwent no degradation nor volume increase for a total integrated dose of 1.8 × 10 to the tenth power rads. Author (NSA)

N71-20388*# Bettis Atomic Power Lab., Pittsburgh, Pa.
THERMAL AND HYDRAULIC EFFECTS OF CRUD DEPOSITED ON ELECTRICALLY HEATED ROD BUNDLES (LWBR DEVELOPMENT PROGRAM)
S. J. Green, B. W. Le Tourneau, and A. C. Peterson Sep. 1970 85 p
(Contract AT(11-1)-GEN-14)
(WAPD-TM-918) Avail: NTIS

Critical heat flux (CHF) and pressure drop tests were performed on four electrically heated 20-rod bundles, using three different rod support systems. The rod bundles were artificially crudded by injection of Fe(OH)2 slurry into the loop containing the heated rod bundle. No effect of crud on CHF was noted at crud levels sufficient to cause up to 100% increase in isothermal pressure drop, most of the crud having been preferentially deposited at the support grids. No very large wall temperature increases were observed due to the crud thermal resistance. An anomalous inlet region failure which occurred during one of the tests is attributed to electrical and mechanical peculiarities of the test section rather than to the crud. Author (NSA)

N71-20551# Babcock and Wilcox Co., Lynchburg, Va. Research and Development Div.
PHYSICS VERIFICATION PROGRAM, PART 3, TASK 4 Quarterly Technical Report, Apr.–Jun. 1970
M. N. Baldwin and M. E. Stern Sep. 1970 12 p refs
(Contract AT(30-1)-3647)
(BAW-3647-18-Pt-3) Avail: NTIS

The effects of lattice inhomogenaities on power profile measurements in water moderated critical assemblies are observed. The sensitivities of solid in-core radiation detectors for neutron flux measurements are determined and reactivity worth measurements on absorber samples of reactor control elements are performed. G.G.

N71-20589# Atomics International, Canoga Park, Calif.
LMFBR PHYSICS PROGRAMS Quarterly Technical Progress Report, Jul.–Sep. 1970

T. H. Springer, R. J. Tuttle, L. A. Mountford, and H. N. Royden
12 Nov. 1970 39 p refs
(Contract AT(04-3)-701)
(AI-AEC-12978) Avail: NTIS

Progress reported in a continuing program of research includes: (1) The central reactivity worths of a wide variety of samples placed in a sodium voided core were analyzed and tabulated. (2) Calculations of the reactivity worth of several U-235, U-238, and PuO2 samples were completed using the modified cross sections obtained from the ESCAPE code. (3) Work was initiated to modify the ESCAPE code in such a way that it will treat samples containing more than one isotope. (4) Resonance region neutron cross section data for Ta-181, Ta-182, W-182, W-183, W-184, and W-186 were evaluated for the ENDF/B data files. (5) To aid in the current ENDF/B evaluation for the isotopes of tantalum and tungsten and in order to apply the results to future ENDF/B cross section evaluations, a number of approaches to provide tools needed for the visual evaluation of measured and calculated data were assessed. (6) A version of SCORE was completed which will allow meaningful testing in practical neutron cross section evaluation situations. D.L.G.

N71-20595# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
STATUS OF PIPE RUPTURE STUDY AT GENERAL ELECTRIC COMPANY, PART 3
S. R. Vandenberg Jun. 1970 72 p refs
(Contract AT(04-3)-189)
(GEAP-10205) Avail: NTIS

A review to determine the effort most needed to improve nuclear system piping analytical and experimental efforts is presented. The accomplishments of a broad program in fatigue studies through both bench scale and large component tests, at-reactor tests of the effect of primary coolant environment on the fatigue behavior of piping steels, fracture mechanics, solution of problems in stress analysis, and failure probability study of actual reactor piping systems are summarized. Author (NSA)

N71-20596# Idaho Nuclear Corp., Idaho Falls.
DEVELOPMENT OF A FULIDIZED BED BURNER FOR PROCESSING ROVER FUEL
L. C. Borduin, D. C. Kilian, and A. P. Roeh Nov. 1970 38 p refs
(Contract AT(10-1)-1230)
(IN-1423) Avail: NTIS

Development of a fluidized-bed combustion process for recovering uranium from spent graphite-matrix nuclear rocket (Rover) fuels is described. The graphite matrix is removed by combustion in a bed of inert alumina particles fluidized by oxygen; the uranium and other metals in the fuel are converted to their oxides. Uranium oxide, U3O8, and other metallic oxides are removed from the burner by elutriation and enter the dissolution phase of the headend process. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N71-19473# Los Alamos Scientific Lab., N.Mex.
THE USE OF A MAGNETIC FIELD TO MEASURE PARTICLE VELOCITY. 1: BASIC CONCEPTS AND EXPLORATORY EXPERIMENTS
J. N. Fritz, R. S. Caird, and R. G. McQueen Dec. 1970 17 p refs
(Contract W-7405-ENG-36; ARPA Order 1124)
(AD-715854; LA-4545-MS) Avail: NTIS CSCL 20/11

Some of the initial effort of Group GMX-6, Los Alamos Scientific Laboratory, in using magnetic fields to measure particle velocities is described. Two types of probes, the U-probe (or Zavoiskii technique) and an axially symmetric probe, are discussed. Some of the preliminary results indicating the possibilities of the techniques are presented and directions for future work are indicated. Author (GRA)

N71-19474# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
PROPAGATION OF STREAMER DISCHARGES FROM BUNDLE CONDUCTORS Final Report, 1 Jul. –30 Sep. 1970
Essam Nasser Dec. 1970 25 p refs
(Contract DI-14-03-0108N)
(PB-196147; ISU-ERI-AMES-91300) Avail: NTIS CSCL 20C

Streamer initiation and propagation depends on the electric field and its distribution in the neighborhood of the surface of the conductor. The propagation extent of the streamers is responsible for the intensity of radio noise generated from the conductor. The steps to be undertaken in this project have been divided into three main phases: (1) calculation of the electrostatic field vector of different conductors everywhere in the gap by digital computer techniques; (2) theoretical derviation of the criteria for the propagation of a positive streamer discharge based on Loeb's theory; (3) experimental determination of the positive streamer propagation on various smooth conductors to verify the theoretical results obtained. Author (GRA)

N71-19488 Rochester Univ., N.Y.
MAGNETIC FIELDS ASSOCIATED WITH SUPERGRANULATION
Howard Kevin Johnson (Ph.D. Thesis) 1969 119 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 70-2879

The magnetic field fine-structure in individual supergranules is studied by using flow models which are stationary in time and spatially periodic. These models exhibit significant field growth in the cellular boundary regions where the flow is strongly converging. The calculations predict the occurrence of small clumps of strong magnetic fields in the interstitial regions bordering on several supergranules; recent observations have substantiated these predictions. The effects of many supergranules on the dispersion and amplification of magnetic fields are determined statistically. The supergranulation flow is treated as a given random velocity field so that the statistics of the associated magnetic field can be determined. The use of turbulent diffusion theory verifies the long-time dispersive effect of the supergranulation flow on the mean magnetic field. Dissert. Abstr.

N71-19489 Rochester Univ. N.Y.
MEASUREMENT OF COMPLEX AMPLITUDE TRANSMITTANCE
Robert Lewis Lamberts (Ph.D. Thesis) 1969 176 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 70-2886

An instrument is described which serves to record the variations of optical path, particularly for small periodic line structures. This is especially useful for studying relief images on photographic films and plates. The instrument contains an interference microscope in which the interference takes place between a beam transmitted by the sample, and a reference beam, which is generated by a Ronchi grating, passed through the sample, and subsequently spatially filtered. Except for the spatial filter, the microscope uses off-the-shelf components throughout. A helium-neon laser is used as a light source. The instrument also includes a system for

scanning the interference fringes and recording the fringe shape, much in the same manner that a microdensitometer records density.
Dissert. Abstr.

N71-19500 Stanford Univ., Calif.
THE THEORY OF LOCALIZED MAGNETIC EXCITATIONS
Charles Michael Hogan (Ph.D. Thesis) 1969 130 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 70-1547

The excitation spectra of ferromagnetic insulators are investigated in the presence and absence of impurities. Three cases are considered: single quantum excitations in a ferromagnet containing two impurity spins, single quantum excitations in a random ferromagnetic alloy, and two-quantum excitations in a pure ferromagnet. The excitation spectrum of a ferromagnet containing one impurity was first solved by Wolfram and Calloway using a Green function technique. This basic method is extended to the problem of two identical impurities separated by an arbitrary distance, and the results may be interpreted as an interaction between the impurities. In the one dimensional case analytical results are obtained which allow an interpretation to be made in terms of the isolated impurity problem. Numerical results are also presented for a simple cubic lattice which have the same qualitative features as one dimension. Dissert. Abstr.

N71-19536# Syracuse Univ., N.Y. Dept. of Electrical Engineering.
THEORY OF COMPUTATION OF CHARACTERISTIC MODES FOR CONDUCTING BODIES
Roger F. Harrington and Joseph R. Mautz Dec. 1970 65 p refs
(Contract F19628-68-C-0180)
(AD-716494; Scientific-9; AFCRL-70-0657) Avail: NTIS CSCL 20/14

A theory of characteristic modes for conducting bodies is developed starting from the operator formulation for the current. The mode currents form a weighted orthogonal set over the conductor surface, and the mode fields form an orthogonal set over the sphere at infinity. It is shown that the modes are the same ones introduced by Garbacz to diagonalize the scattering matrix of the body. Formulas for the use of these modes in antenna and scatterer problems are given. A procedure for computing the characteristic modes for bodies of arbitrary shape is developed, and applied to conducting bodies of revolution and to wire objects. Illustrative examples of the computation of characteristic currents and characteristic fields are given for a cone-sphere, a disk, and a wire arrow. Modal solutions using these modes are computed for representative antenna and scattering problems to illustrate convergence of the solution as the number of modes is increased. For electrically small and intermediate size bodies, only a few modes are needed to characterize the electromagnetic behavior of the body. Author (GRA)

N71-19657# Naval Research Lab., Washington, D.C.
A TEST OF THE CAPABILITIES OF CHIEF IN THE NUMERICAL CALCULATION OF ACOUSTIC RADIATION FROM ARBITRARY SURFACES
A. L. Van Buren 12 Nov. 1970 27 p refs
(AD-716019; NRL-7160) Avail: NTIS CSCL 20/1

The computer program CHIEF was designed by Schenck and Barach of the Naval Undersea Research and Development Center to obtain approximate solutions to exterior steady-state acoustic radiation problems for surfaces of arbitrary shape vibrating with a prescribed normal velocity. To test its capabilities as a research tool, CHIEF was applied to several problems for which accurate answers have been obtained using harmonic expansions. The accuracy and computation time of the results using CHIEF are discussed in terms of the surface subdivision scheme and the number of Gaussian quadrature points used to evaluate the Helmholtz integrals. In addition, new input subroutines to CHIEF which provide numerous geometrical options are also discussed. Author (GRA)

N71-19658# Technion-Israel Inst. of Tech., Haifa. Dept. of Mechanics.
SOURCE EQUATIONS IN CONTINUUM ELECTROMECHANICS
Z. Karni Sep. 1970 20 p refs
(Contract EOOAR-0024-68)
(AD-716567; TDM-70-12; AFOSR-70-2745TR) Avail: NTIS CSCL 20/3

It is shown that the non-conservative balance equation for the linear momentum admits, by a proper choice of the source function which is of single prototype form, all the field equations of continuum electromechanics. They are: the Poissons equations of the gravitational and the electrostatic fields, the four Maxwell equations in their most general form, and also the concept of the Lorentz force. Author (GRA)

N71-19663# Stanford Univ., Calif. Microwave Lab.
INTERNATIONAL CONFERENCE ON THE SCIENCE OF SUPERCONDUCTIVITY Final Report
T. H. Geballe and W. M. Fairbank Apr. 1970 49 p refs Conf. Held at Stanford, Calif., 26–29 Aug. 1969
(Grant AF-AFOSR-1790-69)
(AD-716590; AFOSR-70-2400TR) Avail: NTIS CSCL 20/3

The report summarizes the proceedings of an international conference on The Science of Superconductivity, held 26-29 August 1969 at Stanford University, Stanford, California. The conference was concerned with the fundamental aspects of superconductivity. Invited and contributed papers were presented in ten sessions on Fluctuations, Flux Flow, Josephson Effects, Magnetism, Alloys and Compounds, Tunneling, Type 2 Superconductors, BCS Superconductors, Proximity Effects, and Effective Interactions. Author (GRA)

N71-19664# Catholic Univ. of America, Washington, D.C. Inst. of Ocean Science and Engineering.
UNDERWATER ACOUSTICS Annual Report, Jul. 1969 – Oct. 1970
F. A. Andrews Oct. 1970 37 p refs
(Contract N00014-69-A-0432)
(AD-716016) Avail: NTIS CSCL 20/1

A program of research in underwater acoustics has been in operation at Catholic University for seven years. This is a report for work accomplished in the time period July, 1969, to October, 1970. Twelve articles have been published or accepted for publication, nine papers have been presented at meetings, sixteen articles have been submitted for publication and two reports have been issued. In addition, the program has sponsored the completion of eight doctoral and three masters dissertations. Eleven doctoral and two masters dissertations are in progress. Significant research results are thought to be in acoustic radiation from multiple surfaces, acoustic signature of an imploded submerged body, experimental determination of mutual impedance using face velocity measurements, a monopulse tracking technique for linear arrays, scattering work, sound propagation in wedge shaped shallow water, propagation in a random media and sound radiated by a moving rigid surface. Author (GRA)

N71-19678# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE USE OF A SINGLE PLATE INTERFEROMETER IN THE HOOK-METHOD OF ROSCHDESTVENSKY
Joseph H. Spurk, Edmund J. Gion, and David B. Sleator Oct. 1970 19 p refs
(AD-716335; BRL-1499) Avail: NTIS CSCL 20/6

The theory of a simple inexpensive single plate interferometer coupled to a spectrograph is developed and the feasibility of this instrument in the Hook-method is demonstrated by observing the anomalous dispersion of sodium vapor. This instrument appears especially attractive for use in the vacuum ultraviolet region of the spectrum. Author (GRA)

N71-19679# Rochester Univ., N.Y.
EFFECTS OF ENVIRONMENT ON LOCAL MOMENT FORMATION
K. H. Bennemann and J. W. Garland 14 Dec. 1970 11 p refs Sponsored in part by AEC Prepared in cooperation with Argonne Natl. Lab.
(Contract N00014-67-A-0398-0004)
(AD-716030) Avail: NTIS CSCL 20/12

The effects of local environment on magnetic moment formation are studied, starting from a generalized Hubbard Hamiltonian local moment formation is considered in particular for Au-V and Cu-Ni alloys. It is shown that moment formation is a cooperative phenomenon, which for Cu-Ni cannot be adequately described by purely chemical models. The temperatures for moment formation and for local ordering of the moments are discussed for Cu-Ni. Author (GRA)

N71-19851# Edo Corp., College Point, N.Y.
OBLIQUE INCIDENCE OF COUPLING ACOUSTIC ENERGY. PHASE 1: ACOUSTIC PROPAGATION THROUGH AIR/EARTH INTERFACE Final Report, 1 Aug. 1969 - 31 Jan. 1970
Herbert S. Antman Oct. 1970 60 p refs
(Contract DAAB07-69-C-0378)
(AD-716342; EDO-8930; ECOM-0378-F) Avail: NTIS CSCL 20/1

The purpose of this program was to investigate the feasibility and develop techniques for air-coupling acoustic energy into and through the soil. Acoustics, as well as mechanical probes, thermal detectors, aerial photography, infrared scanners, gravimetric anomaly, microwave radiometry and sonic techniques, have been used previously in experiments to establish their characteristics for propagation through the soil. Possible application of acoustic propagation in soil includes usage in detection, surveillance, or communications. The reason for pursuing acoustics is that until now certain key modes or propagation have been overlooked eg., the shear wave, which has great penetration capability and can sensitively respond to ground stress anomalies. This program was to investigate acoustic energy propagation with an emphasis on shear wave propagation and air-coupling for obtaining practical mobility in any intended application. Author (GRA)

N71-19930# Illinois Univ., Urbana. Charged Particle Research Lab.
CONDUCTION AND PUMPING IN DIELECTRIC LIQUIDS UNDER THE INFLUENCE OF AN APPLIED ELECTRIC FIELD
Kazutoshi Asano and Charles D. Hendricks, Jr. Aug. 1970 152 p refs
(Grants AF-AFOSR-1508-68; PHS-00511)
(AD-716471; CPRL-1-70; AFOSR-70-2814-TR) Avail: NTIS CSCL 20/3

The main objective of this research was to study the charge injection mechanism from a metal to a dielectric liquid with an applied electric field and also to study the fluid motion and pressure which result from motion of the injected charge. A non-uniform electric field system was constructed and corn oil and silicone oil were used as the dielectric liquid. The experimental results indicate that the current and pressure are the same order of magnitude independent of the polarity of the applied voltage. A new interface potential model was proposed to explain these experimental observations. The experimental results also showed that the similar motion of flow inside the test cell as in the calculation was confirmed by the pressure measurement. Author (GRA)

N71-20146# Lamont Geological Observatory, Palisades, N.Y.
PRECISION SOUND VELOCITY PROFILES IN THE OCEAN. VOLUME 6: SOUND SPEEDS AND TEMPERATURES IN AND NEAR THE DEEP PASSAGES OF THE EASTERN CARIBBEAN Final Technical Report, Nov. 1966 - Jul. 1967
Ants T. Piip Aug. 1970 77 p refs
(Contract N00014-67-A-0108-0020)
(AD-716046; CU-1-70; TR-1) Avail: NTIS CSCL 20/1

High precision, high resolution sound speed and temperature profile sequences are presented for 7 near-synoptic stations in the Anegada passage region; 8 near-synoptic stations in the deep passages adjoining Martinique (St. Lucia and Dominica channels); and 4 stations in the Atlantic about a degree east of the Antillean islands. Microstructure of the waters and short-time variability are emphasized. Author (GRA)

N71-20211# ARO, Inc., Arnold Air Force Station, Tenn. Von Karman Gas Dynamics Facility.
SPECTRAL ABSOLUTE REFLECTANCE MEASUREMENTS OF CO2 FROSTS IN THE 0.5 TO 12.0 MICRON REGION
B. E. Wood, A. M. Smith, B. A. Seiber, and J. A. Roux (Tennessee Univ., Tullahoma) *In* NBS Space Simulation Oct. 1970 p 165-183 refs (See N71-20201 09-11)
(Contract F40600-69-C-0001)
Avail: SOD $5.25

In situ absolute reflectance measurements have been made for carbon dioxide frosts formed on liquid nitrogen cooled substrates. Data were obtained spectrally in the wavelength range from 0.5 to 12.0 microns using an infrared integrating sphere. CO2 frosts were found to exhibit an anomalous dispersion reflectance peak at 4.3 microns which was shown to be a very sensitive indication of the presence of solid CO2. Also CO2 frosts scatter short wavelength radiation significantly and semi-transparently for much of the wavelength range between 2.0 and 12.0. The application of these results to problems associated with cryogenically cooled surfaces is discussed. Author

N71-20255*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROPERTIES OF OPTICAL MATERIALS IN SPACE
Fred W. Paul *In* NBS Space Simulation Oct. 1970 p 949-959 refs (See N71-20201 09-11)
(NASA-TM-X-66949) Avail: NTIS; SOD $5.25 CSCL 20F

A program has been established to provide information about the effects of space environment on the optical and physical properties of optical materials. In preparation for some studies of materials at very low temperatures and also during exposure to a charged particle flux, an experiment has been devised and instrumented to provide measurements of dimensional changes and refractive index changes at several wavelengths. The essence of the method is the use of Fabry-Perot interferometry to measure independently the dimensions of the sample and the optical path length through the material. Author

N71-20279*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Space Systems Div.
INVESTIGATION OF EXTERNAL REFRIGERATION SYSTEMS FOR LONG TERM CRYOGENIC STORAGE Final Report
H. L. Jensen, T. C. Nast, A. P. M. Glassford, R. M. Vernon, and W. F. Ekern 22 Feb. 1971 450 p refs

(Contract NAS9-10412)
(NASA-CR-114920; LMSC-A981632) Avail: NTIS HC $6.00/MF $0.95 CSCL 20L

Data and material on external cryogenic refrigeration systems are presented. The data was prepared to evaluate the usefulness of an external cryogenic refrigerator to cool cryogenic storage systems over long periods of time in space. A handbook was prepared that could be used to aid the engineer/planner in performing the trade-off studies that are necessary to evaluate the various options with the use of cryogens in space. Several elements which contribute to the refrigeration system were investigated, and procedures for estimating performance, weight, and volume of each element were established. The major elements of the refrigeration system are the refrigerator itself, the mechanisms to transfer heat from the cryogenic tankage to the radiator, the cryogenic tankage and its insulation, mechanisms to reject heat from the system, and power supplies. The information and data were prepared for a wide range of parameters. Author

N71-20314# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysolikh Energii.
ISOCHRONOUS MAGNETIC OPTICAL SYSTEMS
V. I. Kotov and R. A. Rzaev 1969 18 p refs In RUSSIAN
(IFVE-OP-69-68) Avail: AEC Depository Libraries

On the basis of the formalism of four-dimensional matrices, symmetrical isochronal optical systems are considered. The properties of these systems are investigated on two examples in detail. Author (NSA)

N71-20315# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
CHARGED RELATIVISTIC ELECTRON RING IN THE HELICAL MAGNETIC FIELD
A. G. Bonch-Osmolovsky 1970 21 p refs In RUSSIAN
(JINR-P9-5299) Avail: AEC Depository Libraries

The conditions necessary for the ring equilibrium in the homogeneous and weakly focusing magnetic fields in the presence of the azimuthal component of the magnetic field are given. Author (NSA)

N71-20316# Joint Inst. for Nuclear Research, Dubna (USSR).
MULTIPOLE CURRENT DISINTEGRATION IN CLASSICAL ELECTRODYNAMICS
V. M. Dubovik and A. A. Cheshkov 1970 26 p refs In RUSSIAN
(JINR-P2-5283) Avail: AEC Depository Libraries

A correct solution of the multipole expansion of the electromagnetic current density in classical electrodynamics is given. Author (NSA)

N71-20406# North Carolina Univ., Chapel Hill. Dept. of Physics.
THE EVERETT INTERPRETATION OF QUANTUM MECHANICS
Neill Graham (Ph.D. Thesis) 1970 101 p refs
Avail: NTIS

The Everett interpretation is studied with particular emphasis on four points: the fundamental role played by classical systems and classically describable states, a theory of measurement adapted to an interpretation based on classically describable states, a derivation of the Born interpretation based entirely on the theory of measurement, and a discussion of the well known paradoxes of quantum theory in terms of Everett interpretation. An extensive bibliography on the interpretation of quantum mechanics is given. Author

N71-20554# North Carolina Univ., Chapel Hill. Dept. of Physics.
RESOURCE LETTER ON THE INTERPRETATION OF QUANTUM MECHANICS
Bryce S. De Witt and R. Neill Graham (Concord Coll., Athens, W.Va.) 1970 36 p refs Sponsored by NSF
Avail: Issuing Activity

A selective annotated bibliography on quantum mechanics is presented. The references are grouped into the following categories: early history, Copenhagen interpretation, criticisms of the Copenhagen interpretation, quantum mechanics and philosophy, logical foundations, quantum theory of measurement, Everett interpretation, and hidden variables interpretation. N.E.N.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N71-19445# Pennsylvania State Univ., University Park. Materials Research Lab.
COMPUTER ANALYSIS OF MULTI-CHANNEL SEM AND X-RAY IMAGES FROM FINE PARTICLES
E. W. White, K. Mayberry, and G. G. Johnson, Jr. 22 Dec. 1970 98 p refs Submitted for Publication
(Contract N00014-67-A-0385-0007)
(AD-716562; TR-3) Avail: NTIS CSCL 20/6

Techniques involving the computer processing of scanning electron microscope (SEM) images using a binary coded map approach have been developed. For each picture from one to six different SEM signals are converted from analog to digital form and recorded on magnetic tape for subsequent computer analysis. The analysis of fine grained A1203 particles and multiphase particulate mixtures are carried through from the sample preparation, the actual examination under the SEM, the digital recording of the image and finally the computer processing of the images. The computer program and the results are viewed step by step - with an explanation of the possibilities. A listing of the entire computer program is given in the Appendix. Author (GRA)

N71-19478# California Univ., Berkeley. Lawrence Radiation Lab.
KAON(−) PROTON YIELDS SIGMA HYPERON (+ OR −) + PION (− OR +) BETWEEN 1730 MeV AND 2150 MeV
D. Kane, R. W. Birge, R. P. Ely, Jr., J. Hoven, G. E. Kalmus et al Aug. 1970 15 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev, USSR
(Contract W-7405-ENG-48)
(UCRL-19790; CONF-700806-51) Avail: NTIS

A bubble chamber study was made of the two-body channels Sigma hyperon (+) pion (−) and Sigma hyperon (−) pion (+) produced by scattering a negative kaon beam on protons at 1730 to 2150 MeV. Cross sections, angular distributions, and polarizations were obtained from the data. A conventional partial wave analysis of the data was made, and energy-dependent best fits are summarized. NSA

N71-19476# Washington Univ., Seattle. Dept. of Physics.
SCALING BEHAVIOR IN PROTON PROTON YIELDS PION + ANYTHING AT HIGH ENERGY
N. F. Bali, Lowell S. Brown, R. D. Peccei, and A. Pignotti [1970] 14 p refs
(RLO-1388-583) Avail: NTIS

Evidence is presented that the inclusive reaction proton + proton yields pion + anything approaches a scaling limit at accelerator energies. Author (NSA)

N71-19520 North Carolina Univ., Chapel Hill.
SPIN LATTICE RELAXATION OF V(4 +) PARAMAGNETIC IMPURITIES IN TiO2
Richard Lenoir Sanders (Ph.D. Thesis) 1969 86 p
Avail: Univ. Microfilms: HC $4.60/Microfilm $3.00 Order No. 70-3307

The electron spin-echo technique has been used to measure the spin-lattice relaxation of V(4+) paramagnetic impurities in rutile (TiO2) at liquid-helium temperatures. The relaxation of the z component of magnetiziation shows a time dependence, the sum of two exponentials with two time constants T sub 1A and T sub 1B. In the liquid-helium temperature range, both time constants are independent of temperature. The relaxation times are independent of sample size and surface conditions but are dependent an annealing history. The results of this study suggest that T sub 1B is related to the phonon relaxation time due to crystal-defect scattering. Dissert. Abstr.

N71-19521# Columbia Univ., New York.
REMARKS ON THE ABSOLUTE DELTA I VECTOR = 1/2 RULE IN NONLEPTONIC WEAK DECAYS
T. D. Lee Jul. 1970 19 p refs
(Contract AT(30-1)-1932)
(NYO-1932(2)-184) Avail: NTIS

The soft pion limits for kaon decay amplitudes are reviewed, and it is shown that these soft pion limits do not imply the Delta I = 1/2 rule for the physical nonleptonic kaon decays. Thus the underlying reason for the observed Delta I = 1/2 rule must be due to a different origin. Some speculations on this origin are discussed. NSA

N71-19522 Yale Univ., New Haven, Conn.
EXPERIMENTAL STUDY OF KAON (−) P INTERACTIONS BETWEEN 450 AND 670 MeV/c
Nai-Sitt Wong (Ph.D. Thesis) 1969 114 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 70-2832

140,000 pictures of K(−) with momentum settings 449, 472, 533, 580, 612, and 671 MeV/c were taken in the 30 in. liquid hydroben bubble chamber at Brookhaven National Laboratory. From the analysis of 43,000 events, partial cross sections and angular distributions for the two body channels: negative kaon + P yields negative kaon + P, neutral antikaon + Nucleon, Sigma hyperon + negative pion, negative Sigma hyperon + positive pion, neutral Sigma hyperon, + neutral pion, or Lambda hyperon + neutral pion, as well as the polarizations of the Lambda and the positive Sigma hyperons have been measured. A method of analysis based on weighting each event with the resoltuion functions has been employed to separate the neutral Lambda pion and the neutral Sigma hyperon neutral pion final states. The experimental data have been partial wave analysed with the scattering amplitudes parameterized in terms of a real and symmetric reaction matric so as to satisfy the restrictions imposed by unitarity and time reversal invariance. Apart from the Lambda (1520) whose quantum numbers are well-known, no other resonant states are required by the data in this energy region. Based on the partial cross section in the neutral Lambda pion channel, an upper limit of 0.050 has been set for the elasticity of the recently proposed Sigma(1616) resonance. Dissert. Abstr.

N71-19523# Kentucky Research Foundation, Lexington.
DRIFT MOBILITY OF HOLES IN GERMANIUM BOMBARDED BY FAST NEUTRONS
Ta Hai Yeh (Ph.D. Thesis) 1970 135 p refs
(Contract AT(40-1)-3651)
(ORO-3651-6) Avail: NTIS

The effect of fast neutrons on the electronic transport properties of semiconductors in general, and the effect on minority carrier drift mobility of n-type germanium were studied. The behavior of minority carriers and how the behavior is influenced by the presence of disordered regions was investigated. Measurements were made of the hole drift mobility and dc resistivity versus temperature in n-type germanium which was subjected to successive monoenergetic neutron irradiations. A modified version of the Haynes–Shockley experiment was developed and employed for the drift mobility measurement. Results of measurements made with 14-MeV neutrons indicate that dc resistivity increases with irradiation in accord with the prediction of the theory of the disordered-region model, whereas the hole drift mobility shows a uniform monotonic decrease with irradiation, contrary to preliminary experimental studies with theoretical calculations in which trapping was neglected. NSA

N71-19524# Oak Ridge National Lab., Tenn.
NEUTRON AND SECONDARY GAMMA RAY INDUCED HEAT IN THE GROUND DUE TO POINT 12.2 TO 15 MeV AND FISSION SOURCES AT AN ALTITUDE OF 50 FEET
E. A. Straker, M. B. Emmett, and M. L. Gritzner Nov. 1970 41 p refs
(Contract W-7405-eng-26)
(ORNL-4626) Avail: NTIS

The energy deposited in ground due to neutrons and the secondary gamma rays was determined as a function of range, ground depth, and time from an instantaneous point neutron source with either a fission spectrum or a 12.2 to 15 MeV energy band. In all cases, the source was at a height of 50 feet above the air/ground interface. Discrete ordinates and Monte Carlo calculations illustrate that there is a significant effect on the energy deposited due to source energy distribution, but little effect due to small differences in ground composition. The importance of gamma rays produced by low energy neutrons was found to be small for the 12.2 to 15 MeV source, but large for the fission source. Author (NSA)

N71-19537# California Univ., Berkeley. Lawrence Radiation Lab.
POSSIBLE CONTAMINATION OF GROUND WATER SYSTEM BY HIGH ENERGY PROTON ACCELERATORS
Ralph H. Thomas Oct. 1970 21 p refs Presented at the Symp. of the Health Phys. Soc., Idaho Falls, Idaho
(Contract W-7405-eng-48)
(UCRL-20131; CONF-701106-4) Avail: NTIS

A general evaluation of the problem of possible ground water contamination due to the release of accelerator produced radionuclides to ground shows it to be an unlikely problem for existing and projected high energy accelerators in the energy region of several hundred GeV. Author (NSA)

N71-19538# Pennsylvania Univ., Philadelphia. Dept. of Physics.
CLUSTER MODEL VERTEX FUNCTIONS FOR O-16: BACKWARD ALPHA PARTICLE SCATTERING
J. V. Noble and H. T. Coelho [1970] 31 p refs
(NYO-2171-327) Avail: NTIS

It is shown by direct calculation that the heavy-particle transfer model of backward elastic alpha-particle scattering, together with the assumption of alpha-cluster structure of O-16 and C-12, is capable of explaining the large backward peak in elastic alpha-scattering from O-16. Author (NSA)

N71-19539# Washington Univ., Seattle. Dept. of Physics.
SCALING AND THE ANGULAR DISTRIBUTION OF COSMIC-RAY EVENTS
N. F. Bali, Lowell S. Brown, R. D. Peccei, and A. Pignotti Jul. 1970 12 p refs Sponsored by AEC and NSF
(RLO-1388-587) Avail: NTIS

The nature of the angular distribution of inclusive reactions that follow from the scaling hypothesis is discussed and the

prediction for the reaction proton + proton yields pion+ anything at 250 GeV/c is compared with a new cosmic ray experiment. Author (NSA)

N71-19640# Illinois Univ., Urbana.
FAILURE OF S-CHANNEL HELICITY CONSERVATION IN A1 PRODUCTION
M. L. Ioffredo, G. Ascoli, D. V. Brockway, L. Eisenstein, U. Kruse et al Oct. 1970 7 p refs Presented at the meeting of the Div. of Particles and Fields of the Am. Phys. Soc., Austin, Tex.
(Contract AT(11-1)-1195)
(COO-1195-201; CONF-701108-2) Avail: NTIS

The polarization of the A sub 1 as produced in pion(−) proton yields proton pion (−) pion(+) pion(−) interactions is studied between 5 and 20 GeV/c. It is found that s-channel helicity is not conserved. Instead the density matrix elements have simple behavior with rho sub infinity near 1 for the Gottfried−Jackson frame. A new analysis of the A sub 1 cross section as a function of incident momentum is also shown. Author (NSA)

N71-19641# Massachusetts Univ., Amherst. Dept. of Physics and Astronomy.
CELL MODEL OF A BOSE CONDENSED SOLID
William J. Mullin 17 Dec. 1970 13 p refs
(Contract N00014-67-A-0230-0003)
(AD-716549) Avail: NTIS CSCL 20/12

A cell of a boson quantum system is described. The model has three phases at T= K: normal crystal, Bose condensed liquid,and Bose condensed crystal. The excitation spectrum for the Bose condensed crystal has two branches, a gapless vacancy wave mode and a vacancy-interstitial wave mode with a gap. It is proposed that the phase might be detected by neutron scattering in He-4 near the liquid-solid transition line. Author (GRA)

N71-19601# Michigan Univ., Ann Arbor.
HANLE EFFECT IN 2 1P HELIUM
Edward Strauss Fry (Ph.D. Thesis) 1969 32 p refs
(TID-25588) Avail: NTIS

The oscillator strength for the resonance 11S-21P transition in atomic helium was determined from a measurement of the lifetime of the 21P state. This lifetime was obtained using a modified zero-field level-crossing (Hanle) method. The scattering sample was a thermal-velocity beam of 21S metastable atoms. Resonant 2 muon(21S-21P) radiation is absorbed by the 21S atoms, which are excited to the 21P state. This state then primarily decays to the ground 11S state with the emission of reconance (584-A) radiation. The lifetime of the 21P state was determined from measurements of the magentic-field dependence of the 584-A intensity. This new technique eliminates the problem of constructing a vacuum ultraviolet resonance lamp. The resulting absorption oscillator strength for the resonance transition is 0.270 + or − 0.011. This oscillator strength agrees with the theoretical value. Author (NSA)

N71-19655# Mathematical Applications Group, Inc., White Plains, N.Y.
AUTOMATIC COMPUTATION OF IMPORTANCE SAMPLING FUNCTIONS FOR MONTE CARLO TRANSPORT CODES, PHASE 2 Final Report
Herbert A. Steinberg, Malvin H. Kalos, and Eugene Troubetzkoy Dec. 1970 38 p refs
(Contract DASA01-70-C-0033)
(AD-716453; MR-7013; DASA-2583) Avail: NTIS CSCL 20/8

The report covers the second phase of a program, now in progress at MAGI, to develop procedures for the automatic generation of importance functions for use in three-dimensional Monte Carlo radiation transport codes. The availability of an automatic importance sampling technique will result in significant savings in the time and cost required to run a complex Monte Carlo program. It will also reduce or eliminate the possibility that a wrong answer will be obtained due to incorrect importance sampling. The emphasis during this phase was on analytical studies and the development of techniques, rather than on code development. This approach was necessary, since much of the technology did not exist for immediate code development at the start of the program. As a consequence, the codes that were developed were treated as experimental vehicles to test out the technical ideas presented, rather than an production programs. Furthermore, the emphasis in the code development was in those areas where qualitative ideas had to be tested out and made quantitative, as opposed to implementing known techniques. Author (GRA)

N71-19683 Yale Univ., New Haven, Conn.
AN ISOSPIN CONSERVATION TEST FROM KAON(−) PROTON INTERACTIONS AT 400 MeV/c
Julia Ann Thompson (Ph.D. Thesis) 1969 132 p
Avail: Univ. Microfilms: HC $6.40/Microfilm $3.00 Order No. 70-2817

Antikaon(o) neutron, Lambda hyperon pion(o), and Sigma hyperon(o) pion (o) absolute and differential cross sections, and Lambda hyperon(o) pion and Sigma hyperon(o) pion(o) differential polarizations were obtained from approximately one-third of a million picture exposure to the kaon (−) separated beam in a thirty inch hydrogen bubble chamber with the kaon(−) beam momentum in the middle of the chamber at two central values, 375 and 415 MeV/c. Partial wave solutions were found for the Legendre coefficients, and an upper limit was set on the Lambda hyperon(o)/Sigma hyperon(o) isospin mixing parameter theta due to electromagnetic interactions: Lambda hyperon(physical = Lambda hyperon(isospin zero) cos theta + Sigma hyperon(o) (isospin one) sin theta. Dissert. Abstr.

N71-19694 Kentucky Univ., Lexington.
THE MATRIX ELEMENTS OF THE NUCLEAR SPIN-LATTICE INTERACTIONS IN SOLIDS
Houw Liong The (Ph.D. Thesis) 1969 55 p
Avail: Univ. Microfilms: HC $3.00/Microfilm $3.00 Order No. 70-2601

A general way to expand electromagnetic interaction energy is described with the help of the properties of vectorial spherical harmonics. By expanding the interaction energy between a nucleus and surrounding ions and atoms into magnetic, electric multipole moments, and charge density time-dependent terms, it is possible to estimate relative contributions of these terms to the transition probabilities of the energy exchange between the nucleus and the lattice. It is shown that only electric quadrupole and magnetic dipole moments are important, and that the relative contributions due to the time dependence of the charge density are negligible. It is also possible to see how the matrix elements depend on the eigenvectors of the dynamical matrix of the crystal and on the electronic wave functions. Dissert. Abstr.

N71-19701# Texas A&M Univ., College Station. Dept. of Physics.
THEORY OF FEW PARTICLE DYNAMICS Final Report, 1 Jul. 1969 −30 Sep. 1970
J. Nuttall 1 Oct. 1969 16 p refs
(Grant AF-AFOSR-1817-69)
(AD-716537; AFOSR-70-2468TR) Avail: NTIS CSCL 20/8

Research was concentrated in two main areas of Theoretical Physics, namely the three-body problem and the nucleon-nucleon interaction. Author (GRA)

N71-19717# California Univ., Berkeley. Lawrence Radiation Lab.
EFFECT OF DRIFT TUBE TOLERANCES ON THE ELECTRIC FIELD DISTRIBUTION ALONG THE LENGTH OF AN ALVEREZ CAVITY

Klaus Halbach Sep. 1970 11 p refs Presented at the Proton Linear Accelerator Conf., Batavia, Ill.
(Contract W-7405-eng-48)
(UCRL-19932; CONF-700-929-1) Avail: NTIS

An analysis is presented that shows how small random errors of drift tube diameters, lengths, and positions perturb the electric field distribution in an Alvarez cavity. The field distribution due to the tolerances is calculated from the change of the resonance frequency of individual cells, taking the correlation of the detuning of adjacent cells into account. For all cells, the rms field errors and their correlations are calculated. From these the maximum rms tilt and the most probable distribution of the error fields throughout the cavity are deduced. The change of the resonance frequency of the whole cavity is also calculated. Using a different representation, the rms values of the Fourier coefficients of the field, and their correlations, are given. Author (NSA)

N71-19718 Denver Univ., Colo.
EXCITATION AND IONIZATION PROCESSES IN ARGON COLLISIONS
Paul Osborne Haugsjaa (Ph.D. Thesis) 1969 95 p
Avail: Univ. Microfilms HC $4.80/Microfilm $3.00 Order No. 70-1094

Measurements were made of the total ionization cross section for ground state argon-argon collisions over an energy interval from 1.5 to 500 eV in excess of the ionization threshold in the ionization threshold in the center-of-mass system. The cross section for fast forward directed metastable argon atoms after Ar(+) + Ar charge transferring collisions were measured for low energy collisions. It was found that two maxima in the cross section occurred, one at 14.6 eV and the other at 20.5 eV in the argon ion-atom center-of-mass system. The cross section at the first maximum was estimated to be about 0.001 sq A. The states involved in this excitation were shown to be the two low-lying metastable states of argon at 11.55 and 11.72 eV. Metastable formation during collisions between ground state argon atoms were observed between threshold and 14.5 eV in the center-of-mass system. The cross section for this process was found to be, at the very most, 6 × 10 to the minus 20th power sq cm for the energies studied. Dissert. Abstr.

N71-19737*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
INTERATOMIC FORCES FROM SPECTRAL DATA, AND UTILIZATION OF POTENTIAL CURVES IN SPECTROSCOPY, SCATTERING AND KINETICS
Robert James LeRoy (Ph.D. Thesis) 15 Jan. 1971 212 p refs Sponsored in part by Natl. Res. Council of Can.
(Grants NGL-50-002-001; NSF GB-16665)
(NASA-CR-116978; WIS-TCI-428) Avail: NTIS CSCL 20H

Means of determining diatomic potential curves are discussed, emphasizing utilization of the spectroscopically-observed distribution of vibrational-rotational energy levels. An approach is introduced which allows the determination of the dissociation limit and long range potential tail from the distribution of the uppermost vibrational levels. It also yields a simple expression for the vibrational spacings. Other methods for the determination of diatomic potentials are reviewed, including one utilizing 3-body atomic recombination rate constants. The use of appropriate potential curves allows a better understanding certain physical phenomena. The quasi-bound diatomic levels which lie above the dissociation limit, but are bound by a potential barrier, were studied. Computations are presented for ground state molecular hydrogen, showing extensive barrier penetration. Expectiation values and kinetic energy are calculated for all bound and quasi-bound levels of ground state H2, HD, and D2. A method of calculating exact tunnelling probabilities for one dimensional potential barriers is presented and used to test approximate tunnelling factor formulas for truncated parabolic barriers. Author

N71-19738*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
MOLECULAR CONSTANTS AND INTERNUCLEAR POTENTIAL OF GROUND-STATE MOLECULAR IODINES
Robert J. LeRoy *In its* Interatomic Forces from Spectral Data, and Util. of Potential Curves in Spectry., Scattering and Kinet. 15 Jan. 1971 17 p refs Repr. from J. Chem. Phys., V. 52, no. 5, 1 Mar. 1970 p 2683–2689 (See N71-19737 09-24)
(Grant NSF GP-7409)
Avail: NTIS CSCL 20H

A reanalysis of the spectroscopic data for ground state iodine yields improved rotational constants and vibrational energies which are used to compute a new Rydberg-Kein-Rees potential. Polynomial representations of the vibrational energies and rotational constants are presented which fit all the data to within the respective experimental precision of Verma and of Rank and Baldwin. New approaches are introduced for separately obtaining the rotational Bv and Dv constants and for estimating error bounds for computed RKR turning points. Author

N71-19739*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
DISSOCIATION ENERGY AND LONG RANGE POTENTIAL OF DIATOMIC MOLECULES FROM VIBRATIONAL SPACINGS OF HIGHER LEVELS
Robert J. LeRoy and Richard B. Berstein *In its* Interatomic Forces from Spectral Data, and Util. of Potential Curves in Spectry., Scattering and Kinet. 15 Jan. 1971 12 p refs Repr. from J. Chem. Phys., v. 52, no. 8, 5 Apr. 1970 2869–3879 (See N71-19737 09-24)
(Grant NSF GP-7409)
Avail: NTIS CSCL 20H

An expression is derived which relates the distribution of vibrational levels near the dissociation limit of a given diatomic species to the nature of the long-range interatomic potential. This procedure requires a knowledge of the relative energies and relative vibrational numbering for at least four rotationless levels lying near the dissociation limit. However, it requires no information on the rotational constants or on the number and energies of the deeply bound levels. The dissociation limit can be evaluated with a much smaller uncertainity than heretofore obtainable for Birge-Sponer extrapolations. The formula predicts the energies of all vibrational levels lying above the highest one measured, with uncertainties no larger than that of the binding energy of the highest levels. The validity of the method is tested with model potentials. Author

N71-19740*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
DISSOCIATION ENERGIES AND LONG RANGE POTENTIALS OF DIATOMIC MOLECULES FROM VIBRATIONAL SPACINGS: THE HALOGENS
Robert J. LeRoy and Richard B. Bernstein *In its* Interatomic Forces from Spectral Data, and Util. of Potential Curves in Spectry., Scattering and Kinet. 35 p refs Repr. from J. Mol. Spectrosc., v. 37, 1971 (See N71-19737 09-24)
Avail: NTIS CSCL 20H

A method for obtaining dissociation limits and long range internuclear potentials from the distribution of the uppermost vibrational levels of diatomic molecules is applied to existing data for the B (3 Pi Ou +) states of Cl2, Br2, and I2, and the ground X (1 Sigma g +) state of C12. Values of the asymptotic long range potential constant are deduced from the data; they compare well with the best theoretical estimates. The analysis yields improved ground state dissociation energy values for the ground states of Cl(35,35)2, Br(79,79,)2, Br(81,81)2, and I(127,127)2, respectively, as follows: 19,997.25 (+ or − 0.2)/cm, 15,894 5(+ or −0.4)km, 15,896.6 (+ or −0.5)/cm, and 12,440.9 (+ or − 1.2)/cm. A convenient graphical approximation procedure for tuilizing the method,

and a graphical means of making vibrational assignments for higher levels when utilizing exist in the observed vibrational sequence are also spresented. The latter approach suggests certain vibrational reassignments for ground state of C12 and for the higher state of Br2. Author

N71-19741*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

DISSOCIATION ENERGY AND VIBRATIONAL TERMS OF GROUND STATE (X(1 SIGMA g +)) HYDROGEN

Robert J. LeRoy and Richard B. Bernstein *In its* Interatomic Forces from Spectral Data, and Util. of Potential Curves in Spectry., Scattering and Kinet. 15 Jan. 1971 18 p refs Repr. from J. Chem. Phys., v. 49, no. 10, 15 Nov. 1968 p 4312-4321
(Grants NsG-275-62; NSF GP-7409)
Avail: NTIS CSCL 20H

In an attempt to elucidate the discrepancy between the theoretical and experimental dissociation energies of H2, accurate binding energies and term differences were computed for the 15 vibrational levels using clamped-nuclei potential with its various corrections. The results suggest possible interpretations of the discrepancy. In one of these an extrapolation method is introduced which combines experimental term differences with computed binding energies for the uppermost levels to yield the dissociation energy; this result is in accord with the experimental value. Apparent inconsistencies between previously computed vibrational energies are explained. Author

N71-19742*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

SPECTROSCOPIC REASSIGNMENT AND GROUND STATE DISSOCIATION ENERGY OF MOLECULAR IODINE

Robert J. LeRoy *In its* Interatomic Forces From Spectral Data, and Util. of Potential Curves in Spectry., Scattering and Kinet. 15 Jan. 1971 6 p refs Repr. from J. Chem. Phys., v. 52, no. 5, 1 Mar. 1970 p 2678-2682)
(Grant NSF GP-7409)
Avail: NTIS CSCL 20H

Reanalyzing some early bandhead data for B Ou+(3 Pi) for molecular iodine, an improved value of the ground state dissociation energy is found to be 12,440.9(+ or - 1.1)/cm, differing significantly from the previously accepted value of Verma, 12,452.5(+ or - 1.5)/cm. This result implies that the final state of one of the UV resonance series reported by Verma must have a rotationaless potential maximum some 13.1(+ or -1.4)/cm high. It is further shown that that the original electronic assignment of this state as ground state X Og+(2 Pi) is implausible. A reassignment or Og+(2 Pi) is proposed, and the nature of the Og+(3 Pi) potential is considered. Author

N71-19743*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

SHAPE RESONANCES AND ROTATIONALLY PREDISSOCIATING LEVELS: THE ATOMIC COLLISION TIME DELAY FUNCTIONS AND QUASIBOUND LEVEL PROPERTIES OF H2(X(1 SIGMA g +))

Robert J. LeRoy and Richard B. Bernstein *In its* Interatomic Forces from Spectral Data, and Util. of Potential Curves in Spectry., Scattering and Kinet. 15 Jan. 1971 51 p refs (See N71-19737 09-24)
Avail: NTIS CSCL 20H

The energy dependence of the collisional time-delay function was computed for H(1S) atoms interacting via the ab initio X (1 Sigma g +) potential for molecular hydrogen. Peaks in this function determine the scattering resonance energies and widths, and the lifetimes for each of the corresponding quasi-bound vibrational-rotational levels. Small differences are found between the resonance energies and widths, and the values obtained by a maximum internal amplitude approach (intended to characterize the spectroscopically observable predissociating levels). Approximate procedures for rapid, accurate numerical evaluation of the scattering resonance energies are appraised; a new outer boundary condition criterion for resonances leads to the best agreement with the exact results. Also, a primitive WKB procedure yields widths of usable accuracy. For ground state H2, HD and D2, the onset of line broadening due to centrifugal barrier penetration is found to occur at energies some hundreds of 1/cm below the locus of barrier maxima. The predissociation method of estimating long range interatomic forces therefore cannot be expected to yield valid results for hydridic diatomics. Author

N71-19744*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

EIGENVALUES AND CERTAIN EXPECTATION VALUES FOR ALL BOUND AND QUASIBOUND LEVELS OF GROUND STATE (X (1 SIGMA g +)) H2, HD AND D2

Robert J. LeRoy *In its* Interatomic Forces from Spectral Data, and Util. of Potential Curves in Spectry. Scattering and Kinet. 15 Jan. 1971 25 p refs (See N71-19737 09-24)
Avail: NTIS CSCL 20H

The eigenvalues, and the expectation values of R, sq R, 1/sq R, and kinetic energy were calculated for all vibrational-rotational levels of the ground states from the relativistic, adiabatic potential. The widths are also given for all quasi-bound levels for which the width is between 0.05/cm and 100/cm. Author

N71-19745*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

PERMEABILITY OF ONE DIMENSIONAL POTENTIAL BARRIERS

Robert J. LeRoy, K. A. Quickert (Toronto Univ.), and D. J. LeRoy (Toronto Univ.) *In its* Interatomic Forces from Spectral Data, and Util. of Potential Curves in Spectry., Scattering and Kinet. 15 Jan. 1971 11 p Repr. from Trans. Faraday Soc. (England), v. 66, 1970 p 2997-3008 (See N71-19737 09-24)
Avail: NTIS CSCL 20H

A numerical method is described for computing the exact permeability (tunnelling probability) for any one-dimensional potential barrier. It is used to test the validity of the widely-used approximate formulae for the tunneling factors for truncated parabolic barriers. The method is also used to calculate tunneling factors for the H + H2 exchange reaction, and it is shown that standard Eckart and parabolic barrier approximations can yield considerable error. Author

N71-19746*# Wisconsin Univ., Madison. Theoretical Chemistry Inst.

DISSOCIATION ENERGIES OF DIATOMIC MOLECULES FROM VIBRATIONAL SPACINGS OF HIGHER LEVELS: APPLICATION TO THE HALOGENS

Robert J. LeRoy and Richard B. Bernstein *In its* Interatomic Forces from Spectral Data, and Util. of Potential Curves in Spectry., Scattering and Kinet. 15 Jan. 1971 4 p refs Repr. from Chem. Phys. Lett. (Amsterdam), v. 5, no. 1, 15 Feb. 1970 p 42-44
Avail: NTIS CSCL 20H

The distribution of vibrational levels near the dissociation limit, governed mainly by the long-range part of the potential can be WKB-approximated to yield a simple expression which prmits accurate determination of the dissociation limit. Improved ground state dissociation energies are presented for Cl2, Br2, and I2. Author

N71-19747*# Toronto Univ. (Ontario). Lash Miller Chemical Labs.

RECOMBINATION OF IODINE ATOMS IN DILUTE SOLUTIONS OF ARGON

G. Burns, Robert J. LeRoy, D. J. Morriss, and J. A. Blake *In*

Wisconsin Univ. Interatomic Forces from Spectral Data, and Util. of Potential Curves in Spectry, Scattering and Kinet. 15 Jan. 1971 16 p refs Repr. from Proc. Roy. Soc. (London), Ser. A, no. 316, 1970 p 81-96
Avail: NTIS CSCL 20H

The reaction 2I + Ar yields I2 + Ar was studied at 298, 323, and 423 K by flash photolysis. The overall rate constant falls below extrapolated values for I2/Ar < approximately 0.0001. The fall-off is explained in terms of a mechanism involving an IAr intermediate: the reversible I + Ar = IAr, and IAr + I yields I2 + Ar. The equilibrium separation in such an IAr complex is 0.55 nm and the binding energy is 6.3 kj/mol. This mechanism predicts the onset of the fall-off in agreement with the available experimenwl data. The temperature dependence of this onset and of the recombination rate constant from 298 to 1500 K are also explained. The new mechanism also yields quantitative agreement between the new rate constants and those reported previously. These combined data for 298 K yield a value of 3.00 (+ or −0.16) × 10 to the 9th power sq l/sq mol/sec for the rate constant for the reaction 2I + Ar yields I2 + Ar, and one of 1.00 (+ or −0.09) × 10 to the 12th power sq l/sq mol/sec for 2I + I2 yields 2I2. Most available experimental data could be explained if it were assumed that the recombination proceeds via an unobserved electronically excited I2, formed from two 2P3/2 atoms, with a potential well 21 to 29 kj/mol deep. Author

N71-19766 Yale Univ., New Haven, Conn.
KINEMATICAL PROPERTIES OF SCATTERING AMPLITUDES
Ralph Francis Guertin (Ph.D. Thesis) 1969 181 p
Avail: Univ. Microfilms: HC $8.40/Microfilm $3.00 Order No. 70-2734

A study was made of the kinematical properties in four-momenta space of scattering amplitudes involving massive particles using the M-function, or spinor amplitude, formalism. Complex convariance at points where the scattering functions were holomorphic was employed to find points where there were kinematical restrictions and the effect of discrete symmetries was accounted for. It is shown that, for functions involving four particles, a decomposition into sums involving invariant amplitudes free of any kinematical singularities or zeroes and kinematical factors, or standard covariants, is possible, provided the latter have the same kinematical properties as the scattering functions. Standard covariants are explicitly constructed for all cases where two of four particles have spins and many examples are given for the four spin case. The approach is compared to the use of center-of-mass helicity amplitudes and the problems involved in finding invariant amplitudes for more than four particles are discussed. Dissert. Abstr.

N71-19767 California Inst. of Tech., Pasadena.
A STUDY OF THE BOUND STATES OF O 15 AND A STUDY OF T = 3/2 STATES IN C 13, O 17, and Ne 21
David Cecil Hensley (Ph.D. Thesis) 1969 248 p
Avail: Univ. Microfilms: HC $11.25/Microfilm $3.20 Order No. 70-548

The bound states of O-15 were studied in the O-16(He-3, alpha)O-15 reaction, and the binding energy of the 6th excited state of O-15 with respect to N-14 + p was measured. In addidion, T = 3/2 states in C-13, O-17, and Ne-21 were studied in the He-3, proton) reaction on B-11, N-15, and F-19 and in the (He-2,alpha) reaction on C-14, O-18, and Ne-22. In all cases, the reaction products were analyzed with a 61 cm radius, double-focusing magnetic spectrometer and detected by a 16 counter array in the focal plane of the spectrometer. Analog-state correspondences were made on the basis of relative intensities, excitation energies, and spin-parity assignments; four completed T = 3/2 quartets were established. The completed T = 3/2 quartets were then used to test the quadratic mass equation for isobaric multiplets. Dissert. Abstr.

N71-19768 Texas Technological Coll., Lubbock.
SELECTED PROBLEMS IN THE THEORY OF INTERNAL ROTATION IN COMPLETELY ASYMMETRIC MOLECULES
John Virgil Knopp (Ph.D. Thesis) 1969 112 p
Avail: Univ. Microfilms: HC $5.60/Microfilm $3.00 Order No. 70-1476

A general theory for internal rotation in a two-top molecule was developed. The molecular model is restricted only by the condition that both tops and also the frame have planes of symmetry. The kinetic energy is first expressed in terms of a five-component angular velocity vector and a five-dimensional moment of inertia tensor. The quantum mechanical Hamiltonian and various methods of obtaining energy eigenvalues are developed and discussed. The theory is applied to dimethyl silane and ethyl alcohol. A quasi-potential hindering internal rotation in completely asymmetric molecules is discussed. The origin of this quasi-potential is due to the contributions of the zero point vibrational energy and Coriolis coupling between vibration and internal rotation. The effect of the quasi-potential on the three torsional sublevels in CH2DSH is analyzed. Dissert. Abstr.

N71-19852# WADCO Corp., Richland, Wash.
ANALYSIS OF ZPPR/FTR SHIELD EXPERIMENTS: NEUTRON DISTRIBUTION
E. T. Boulette Oct. 1970 121 p refs
(Contract AT(45-1)-2170)
(WAAN-FR-12) Avail: NTIS

Two-dimensional diffusion theory calculations are shown to predict realistically the measured neutron-induced reaction rates of U-238(n, f), Pu-239(n, f), B-10(n, alpha), Na-23(n, gamma), and Mn-55(n, gamma) throughout the core, reflector, and radial yield of test assembly FTR-2, which was loaded in the zero power plutonium reactor facility. In the areas where disagreement between the calculations and measurements was noted, the measurements provide a basis for any required empirical adjustments in design calculations to assure that the fast test reactor radial yield performs satisfactorily. Author (NSA)

N71-19866 Rensselaer Polytechnic Inst., Troy, N.Y.
NEUTRON SCATTERING MEASUREMENTS IN THE RESONANCE REGION
Thomas J. King (Ph.D. Thesis) 1969 193 p
Avail: Univ. Microfilms HC $8.80/Microfilm $3.00 Order No. 70-2624

Neutron scattering in tungsten, rhodium, cadmium, and Pu-239 was measured in the energy region below 1400 eV using two Li-6 glass scintillators as the neutron detectors and a 1.25 meter diameter large liquid scintillator as an anti-coincidence mantle to reduce the background. The source of neutrons was the Rensselaer LINAC. Spin assignments and parameter determination were made for 7 resonances in W, 7 resonances in Rh, 5 resonances in Cd, and 8 resonances in Pu-239. In addition, information about the ratio Gamma sub n/Gamma for 10 resonances in Cd (from 300 to 1400 eV) is given. Where comparisons could be made, these results are in good agreement with other experimental results. Dissert. Abstr.

N71-19867 New York Univ., N.Y.
ELECTRON PARAMAGNETIC RESONANCE OF DIVALENT MANGANESE IN ZINC PERCHLORATE AND DIVALENT NICKEL IN ZINC FLUOROSILICATE WITH A PARALLEL AND PERPENDICULAR CONFIGURATION
Ian James Fritz (Ph.D. Thesis) 1969 98 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 70-3065

The EPR spectra of Zn(C104)2·6H20:Mn(++) and ZnSiF6·6H2O:Ni(++) obtained with the microwave and static magnetic fields parallel as well as perpendicular are studied.

Theoretical calculations, based on the spin Hamiltonian formalism, of the line positions and relative intensities are presented and compared with the experimental results. For Mn(++) the relative transition probabilities for the parallel configuration are found to have a particularly simple form. Comparison of the spectra for the parallel and perpendicular configurations yields a simple, direct determination of the signs of the parameters A and B relative to D. The values, in gauss, of the parameters in the spin Hamiltonian for MN(++) are found to be D = + or − 127 + or − 1, a= + or − 9.5 + or − 1, A= − or + 95.8 + or − 3, B= − or + 96.1 + or − .3; g is 1.999 + or − .001. For NI(++) the parameters in the spin Hamiltonian are found to be D = 1838 + or − 15 gauss and G = 2.23 + or − .01, with g isotropic.
Dissert. Abstr.

N71-19868 St. Louis Univ., Mo.
AN SU(3) MODEC OF CP-VIOLATION
David Bradford Tribble (Ph.D. Thesis) 1969 147 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 70-1875

The decays of the pseudoscalar mesons are studied within the framework of unitary symmetry and the current-current hypothesis of weak interactions. Octets of vector and axial-vector weak mesonic currents are defined in terms of the Kemmer field of relativistic SU(6). Lagrangians constructed by the coupling of currents are assumed to conserve CP as well as strangeness in a Cabibbo frame. In order to introduce the observed violation of CP-invariance in the non-leptonic decays of the K-mesons, Cabibbo's transformation is extended by including F sub 6 as well as F sub 7 rotation. The coupling of the vector and axial-vector parts of the weak mesonic current with the lepton current yield rates of decay which are independent of the F sub 6 rotation. Thus, Lagrangians for the leptonic and semi-leptonic decays of the pseudoscalar mesons reproduce the results of Cabibbo. The possibility of direct Delta S = 2 transitions in the neutral kaon system is considered. A model of CP-violation is then constructed on the basis of direct DeltaS = 2 transitions.
Dissert. Abstr.

N71-19892# Washington Univ., Seattle. Dept. of Physics.
SUMMING SOFT PIONS
Lowell S. Brown [1970] 11 p refs
(Contract AT(45-1)-1388)
(RLO-1388-589) Avail: NTIS

A simple derivation of Weinberg's result on the chiral symmetric coupling of soft pions to a high-energy process is presented. The formula for soft virtual pion corrections is shown to be not invariant under canonical transformation of the pion field. Thus, this formula is model-dependent and not a consequence of chiral symmetry.
Author (NSA)

N71-19895# International Centre for Theoretical Physics, Trieste (Italy).
RENORMALIZATION CONSTANTS AND INTERRELATION OF FUNDAMENTAL FORCES
Abdus Salam Sep. 1970 27 p refs Presented at the 15th Intern. Conf. on High Energy Phys., Kiev, 26 Aug. –4 Sep. 1970
(IC-70/106) Avail: AEC Depository Libraries

The problem of ambiguities in finite computations of renormalization constants for nonpolynomial Lagrangians in field theory is considered. The procedure is suggested to obtain from experiment the dependence of the normalization constants on physical coupling constants and to formulate a maximum analyticity principle based on the analytic dependence of the Lagrangians. Some qualitative and preliminary conclusions are made concerning the magnitudes of the finite renormalization constants within the context of this procedure. The strong chiral Lagrangians, weak Lagrangians with ther Fermi constants, and Einstein's gravitational Lagrangian with the newtonian constant are considered. A review of the present status of the ambiguity problem and the procedure for the computation or renormalization constants are given.
NSA

N71-19896# California Univ., Berkeley. Lawrence Radiation Lab.
METHOD FOR OBTAINING LINAC BEAMS OF CONTINUOUSLY VARIABLE ENERGY
Frank B. Selph Sep. 1970 13 p refs Presented at the Proton Linear Accelerator Conf., Batavia, Ill.
(Contract W-7405-eng-48)
(UCRL-19901; CONF-700929-2) Avail: NTIS

The beam energy obtained with an Alvarez linac is normally determined within narrow limits by the design energy of the synchronous particle. In the SuperHilac poststripper, the tank is divided into several separately excited sections. In each section, varying the electric field from zero to maximum causes the energy increment of that section to vary from zero to the maximum (synchronous value). By so adjusting each of 5 sections, the output energy can be varied continuously from 2.6 to 8.5 MeV/N. Some aspects of the expected behavior of the partial energy beams are discussed, particularly the energy spread. A formula is suggested whereby results obtained for the heavy ion linac can be scaled to predict variable energy performance of other linacs.
Author (NSA)

N71-19920 Tennessee Univ., Knoxville.
EXAMINATION OF THE CONSERVATION LAWS IN A PARTICULAR CLASS OF COLLISIONS OF THE SECOND KIND
Wheeler Kesey McGregor, Jr. (Ph.D. Thesis) 1969 223 p
Avail: Univ. Microfilms: HC $10.15/Microfilm $3.00 Order No. 70-2123

The detailed structures of the vibrational bands of the first negative and second positive systems of nitrogen resulting from excitation collisions with helium and argon metastable atoms are examined. The resulting spectra, measured using a one-meter spectrometer having a resolution of 0.05 A in the second order, exhibit band structure of exceptional quality. Bands originating from the v = 0 level exhibit rotational structure out to rotational quantum numbers of about 70. The absolute intensities of the rotational lines which are undisturbed by adjacent lines are listed in the dissertation. An examination of the spectra in the light of the basic conservation of energy, angular momentum, and parity suggests that the mechanism of the excitation is an electron exchange between the collision partners. The data also indicate that all transitions fall within the realm of prediction when a dipole, or vector, potential perturbation is used. All vibrational transitions follow the Franck-Condon principle; they are vertical collisions.
Dissert. Abstr.

N71-19924# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
MODEL OF THE RIGID NONAXIAL ROTATOR FOR THE ODD ATOMIC NUCLEI
R. A. Sardaryan 1970 16 p In RUSSIAN
(ITF-70-44) Avail: AEC Depository Libraries

The model of the odd nonaxial nucleus is considered with the added restriction that the projection of the external nucleon moment on the axis is conserved. This assumption, valid for small deviations of the shape of the nucleus from the axial-symmetric one, essentially simplifies the Hamiltonian and allows the study of the main and anomalous rotational bands constructed on the ground state of the nucleus. The calculated spectra are compared with the experimental ones of the spin-5/2 nuclei Re-183, Re-185, Re-187, Yb-169, Yb-171, Yb-173, Er-169, and Er-171.
Author (NSA)

N71-19926 Boston Coll., Chestnut Hill, Mass.
EPR OF Ti(2+) and Mn(2+) – F(–) SHFS IN THE ALKALINE EARTH FLUORIDES
William Robert Kritzler (Ph.D. Thesis) 1969 180 p
Avail: Univ. Microfilms: HC $8.20/Microfilm $3.00 Order No. 70-2014

The method of electron paramagnetic resonance spectroscopy was used to investigate Ti(2+) and the Mn(2+)F(−) super-hyperfine interaction in the alkaline earth flourides at X-band microwave frequencies. Ti(2+) in CaF-2, SrF-2, and BaF-2 yields isotropic spectra with g = 1.942 + or − 0.001, g = 1.930 + or − 0.001 and g = 1.927 + or − 0.002 respectively. The theoretical isotropic g is given by g = 2 to 8 lambda/delta. For the CaF-2 host, delta = 7450 deg/cm yielding lambda = 54.0/cm. As the free ion lambda sub o = 60.5/cm, this represents a reduction of 11% and is ascribed to covalency. Absence of optical data for SrF-2 and BaT-2 hosts prevent calculation of lambda for Ti(2+) in these hosts, but the decreasing g values are consistent with theory.
Dissert. Abstr.

N71-19927 Syracuse Univ., N.Y.
FIRST ORDER RADIATIVE ELECTRON TRANSFER FROM NEUTRAL DONORS TO NEUTRAL ACCEPTORS IN SILICON
Bruce Friedman (Ph.D. Thesis) 1969 186 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 70-1950

Expressions were obtained for the first-order radiative transition rate which describes the first-order radiative process which occurs when electrons transfer from neutral donors to neutral acceptors in silicon at liquid helium temperatures. Effective-mass theory and wave functions expanded in series are used to obtain the required expressions. With the use of recombination rate theory, the theory and experiment are compared. Experimental data indicates a discrepancy of two to three orders of magnitude between the experimental and theoretical values.
Dissert. Abstr.

N71-19929 Texas Christian Univ., Fort Worth
MAGNETO OPTICAL STUDY OF MAGNETIC FIELD DEPENDENCE OF SPIN LATTICE RELAXATION TIMES IN CaF2-Eu(2+)
Beverly Sue Burt Giltner (Ph.D. Thesis) 1969 174 p
Avail: Univ. Microfilms: HC $8.00/Microfilm $3.00 Order No. 70-1988

A magneti-optical technique was developed to measure the spin; lattice relaxation time of paramagnetic ions in a crystal lattice as a function of applied static magnetic field strength. This method utilized the Faraday effect at low temperatures. An ac magnetic field modulated the Faraday rotation of plane polarized light traversing the sample. The phase angle between the diamagnetic rotation and the total rotation was measured as a function of frequency of the modulating magnetic field. When the frequency of modulating field exceeded the inverse spin-lattice relaxation time, the modulation of the light due to paramagnetic contributions was diminished leaving only the modulation due to diamagnetic contributions. From these measurements the spin-lattice relaxation time was determined. The spin-lattice relaxation times for divalent europium ions in a CaF2 lattice at 9 K were measured as a function of applied dc magnetic field strength from 0 − 5760 Oe. The results obtained by the above method agreed satisfactorily with other reported spin-lattice relaxation times obtained by electron paramagnetic resonance techniques at the same magnetic field.
Dissert. Abstr.

N71-19934 Rensselaer Polytechnic Inst., Troy, N.Y.
THEORY OF COUPLED SPACE-TIME EFFECTS IN FAST PULSED NEUTRON KINETICS AND TRANSPORT THEORY
Harold N. Knickle (Ph.D. Thesis) 1969 925 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 70-2625

Only nonmultiplying and subcritical multiplying systems are considered. Two functionals were developed with analytic time dependence and numerical space and energy dependence to predict neutron distributions. The functionals, or models, one for multiplying media and the other for nonmultiplying media are intuitive physically. The space and energy numerical dependence can be found from a numerical calculation of time moments by either a diffusion theory or transport theory code. The time moments themselves add a great deal of quantitative physical information to the functionals. A time dependent numerical code was developed based on the double spherical harmonics approximation. The treatment of the spatial dependence is limited to heterogeneous slab geometry. Comparisons of the functionals with exact diffusion theory solutions has shown good agreement.
Dissert. Abstr.

N71-19936 St. Louis Univ., Mo.
MAGNETIC RESONANCE OF NaCl-Cl2(−) AND LaES-Gd(3+)
Ralph James Richardson (Ph.D. Thesis) 1969 96 p
Avail: Univ. Microfilms: HC $5.00/Microfilm $3.00 Order No. 70-1867

A qualitative investigation was made into the behavior of the dynamic nuclear polarization arising from the solid state effect in polycrystalline substances containing paramagnetic centers for which the g and/or hyperfine tensor is substantially anisotropic. Sodium-23 NMR enhancements in powdered NaCl crystals by saturating the Cl2(−) ESR spectrum. The NMR enhancement data were found to follow closely the shape of the Cl2(−) ESR spectrum as predicted. Electron spin resonance measurements at 9.4 kMc/sec were made on single crystals of lanthanum ethyl sulfate (LaES) containing small amounts (approximately 0.1 and 1.0 weight percent) of Gd(3+) ions (an S-state ion with an S-8(7/2) ground state). Satellite lines were observed on the well-known seven line ESR fine structure spectrum of Gd(3+). Proton NMR enhancement experiments indicate that these satellites are due to mutual spin flips of the Gd(3+) ions and nearby proton nuclei contained in the waters of hydration of the crystal.
Dissert. Abstr.

N71-19945# Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.
REVIEW OF THE SOLID SOLID REACTIONS OF CARBON AND SILICON CARBIDE WITH URANIUM DIOXIDE AND OF OXIDATION OF SILICON CARBIDE
J. A. Crofts Jun. 1970 36 p refs
(RD/B/M-1589) Avail: AEC Depository Libraries

The production of uranium carbides by the carbothermic reduction of UO2 is reviewed and the effects of CO pressure and stoichiometry of UO2 on the rate and mechanism of UO2−C reactions are discussed. Reactions with SiC with UO2 and the oxidation of SiC by gases and by SiO2 are considered. The inhibition of SiC oxidation by added gases and the possible catalytic effect of fission products of uranium on the UO2−C and UO2−SiC systems are also discussed.
Author (NSA)

N71-19971 Yale Univ., New Haven, Conn.
MANY-ELECTRON THEORY: RELATIVISTIC AND NON-RELATIVISTIC STUDIES
Tai-ichi Shibuya (Ph.D. Thesis) 1969 254 p
Avail: Univ. Microfilms: HC $11.50/Microfilm $3.00 Order No. 70-2804

A perturbation theory is developed for the spin symmetry adapted spatial wave functions of many-electron systems, based on symmetric permutation group theory. Closed shell systems group theoretical arguments, and open shell systems are discussed. A density matrix formulation of correlated many-fermion systems is presented for nonrelativistic theory. A critical survey of the studies on relativistic effects in atoms and molecules is made, and an approach for relativistic correlation problems is given.
Dissert. Abstr.

N71-19972 New York Univ., N.Y.
MODEL CALCULATIONS OF NUCLEAR STRUCTURE EFFECTS ON ATOMIC SPECTRA

Harvey J. Rosenberg (Ph.D. Thesis) 1969 129 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 70-3100

The nuclear charge structure effect on the hyperfine structure interaction is calculated for a realistic charge distribution as obtained from high-energy electron scattering experiments. A polynomial approximation is used to represent the charge distribution and a series solution is obtained for the Dirac equation of the electron in this field to calculate the correction. Next, the Nilsson model of the nucleus was used in an attempt to account systematically and simultaneously for changes (sq R) which which reflect both the size and deformation effects of the nuclear charge distribution in isotope shift. Calculations are carried out for the isotopic pairs: Eu-151/Eu-153 and Pm-147/Pm-151. These nuclei are not only highly deformed but the deformations also change appreciably in passing from the lighter to the heavier member of the isotopic pair. Finally, the nuclear shell model with configuration mixing is used to calculate the magnetic octupole moments of some recently-measured nuclei: Br-79, Br-81, Kr-83, Xe-131, and Hg-201. Dissert. Abstr.

N71-19973 Texas Christian Univ., Fort Worth.
ELECTRON IMPACT ELASTIC AND IONIZATION CROSS-SECTIONS FOR ATOMIC NITROGEN
Robert Micheal O'Donnell (Ph.D. Thesis) 1969 125 p
Avail: Univ. Microfilms: HC $6.00/Microfilm $3.00 Order No. 70-1991

Elastic and differential elastic cross sections were calculated for an incident electron energy of 2.0 Rydbergs. The differential ionization cross section for ejection of a 2p electron having a kinetic energy of 0.43 Rydbergs was also computed. The wave function of the atom-electron system was approximated by the superposition of the initial target state of the overall system and the final continuum state. The continuum state was treated by restricting the integration over momentum space to a narrow band of movementum for the ejected electron. This restriction caused the elastic and inelastic differential equations to uncouple and allowed them to be solved separately. Both the elastic and inelastic wave functions were determined numerically by means of a partial wave analysis. The effects of exchange were accounted for by expressing all wave functions in the form of a Slater determinant. It was found that, for an incident energy of 2 Rybergs, the inclusion of exchange is very important. Dissert. Abstr.

N71-19976# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
ANGULAR AND ENERGY DISTRIBUTIONS OF PARTICLES PRODUCED IN THE INELASTIC PION-NUCLEON AND NUCLEON-NUCLEON COLLISIONS AT SUPER HIGH ENERGIES
V. S. Barashenkov and S. M. Eliseev 1970 18 p refs In RUSSIAN
(JINR-P2-5331) Avail: AEC Depository Libraries

For the energies more than several dozens of GeV an analytical approximation of the experimental angular and energy secondary particle distributions in the c.m.s. is obtained. This approximation is conveniently applied for calculation of the intranuclear cascades at superhigh energies according to the Monte-Carlo method. Author (NSA)

N71-19977 Rensselaer Polytechnic Inst., Troy, N.Y.
THE (gamma, xn) REACTIONS IN Tm 169
John Carl Leader (Ph.D. Thesis) 1969 187 p
Avail: Univ. Microfilms: HC $8.60/Microfilm $3.00 Order No. 70-2627

The cross sections for Tm169 (gamma,xn) Tm169(−x) reactions were measured for 1 < or = to x < or = to 6 using bremsstrahlung with end-points from 20 MeV to 75 MeV. Cross sections were obtained by analysis of yield rates calculated from the activities induced in thulium measured with a Ge(Li) detector. Neutron energy spectra, obtained by time-of-flight measurements, were also obtained from thulium at several bremsstrahlung energies and angles. Analysis of these energy spectra data provided lower limits on the differential cross sections for neutrons arising from (gamma,n) and (gamma,2n) reactions. Dissert. Abstr.

N71-19978# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physics Inst.
MEASUREMENT OF THE ANGULAR CORRELATION COEFFICIENT IN NEUTRON DECAY Final Scientific Report, 1 Feb. 1969 −31 Jul. 1970
Peter Weinzierl and Helmut Paul 20 Oct. 1970 14 p refs
(Contract F61052-69-C-0039)
(AD-716464; AFOSR-70-2815TR) Avail: NTIS CSCL 20/8

The document is a continuation of the work started under Contract 61(052)-857. The aim is to determine the angular correlation constant, and hence, the coupling constant ratio C sub A/C sub V, in neutron beta decay by measuring the shape of the proton recoil spectrum. Further preliminary investigations were done concerning the effect of neutron motion and finite spectrometer resolution upon the spectrum, on the optimization of the measurement cycle, and on the appearance of surface charges under electron irradiation. The beam tube insert and the vacuum system have been assembled and tested. The magnetic shielding inside the beam tube was tested. The proton test source has been finished. The proton detector has been tested, and it was possible to reduce the background counting rate to a sufficiently low value. The control and data output system has been finished and tested. An evaluation of coupling constants in beta decay using published data was done by means of a computer program. Author (GRA)

N71-19988# Commissariat a l'Energie Atomique, Limeil (France). Centre d'Etudes.
GAMMA-RAY PRODUCTION CROSS SECTIONS FOR 5 MeV, 6.6 MeV, AND 8.7 MeV NEUTRONS WITH NITROGEN, OXYGEN, SCANDIUM, AND GOLD [SECTIONS EFFICACES DE PRODUCTION DE RAYONNEMENT GAMMA PAR DES NEUTRONS DE 5 MEV, 6.6 MEV ET 8.7 MEV SUR L'AZOTE, L'OXYGENE, LE SCANDIUM ET L'OR]
Andre Bertin, Francoise Bertrand, and Genevieve Clayeux Aug. 1970 39 p refs In FRENCH
(CEA-R-4047) Avail: AEC Depository Libraries

The inelastic scattering of fast neutrons by nitrogen, oxygen, scandium, and gold was investigated to determine cross sections for gamma ray production. A single-crystal NaI(Tl) spectrometer was used to detect the gamma rays emitted by the samples. Cross sections for the production of 1.63, 2.31, and 4.46 MeV gamma rays by N-14, 6.13 MeV gamma rays by O-16, and 0.718 and 1.238 MeV gamma rays by Sc-45 were measured at the angles: 30, 45, 60, 90, and 120 degrees. An integrated gamma ray production cross section for gold is given for energy groups from 0.5 to 7 MeV. Cross sections are given in mb/sr with an accuracy of + or − 14% for the E sub gamma = 2 MeV energy range and of + or − 20% in the upper range. Author (NSA)

N71-19990# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
CROSSED CHANNEL EXCHANGE AND REGGE ASYMPTOTIC BEHAVIOUR OF SCATTERING AMPLITUDES: COMPARISON OF INFINITE ONE PARTICLE EXCHANGE MODEL WITH VENEZIANO MODEL
Mamoru Kawasaki (Hiroshima Univ.) and Masanori Kobayashi Dec. 1970 20 p refs
(RIFP-112) Avail: NTIS

An infinite one-particle-exchange (IOPE) model is compared with the Veneziano model from the viewpoint that the Regge behaviour is due to crossed channel exchanges. It is shown that the

term which induces the Regge behaviour in the Veneziano model is distinct from the IOPE amplitude. The former does not satisfy crossing symmetry and has complex coupling constants. Author

N71-19991# Montpellier Univ. (France). Dept. de Physique Mathematique.
NUMERICAL COMPUTATIONS IN THE INVERSE SCATTERING PROBLEM AT FIXED ENERGY
Pierre C. Sabatier and F. Quyen Van Phu Nov. 1970 22 p refs
(PM/70/3) Avail: NTIS

The construction of potentials from the phase-shifts at a given energy which yields an infinity of equivalent solutions is presented. The deviations of these solutions from each other are analyzed, according to a priori limitations on the derivatives and other features of acceptable potentials. A sketch of this analysis is given, together with a numerical comparison of usual potential forms with the equivalent potentials obtained through Newton's method. The observed deviation gives an appraisal of the deviation from each other of all the equivalent potentials with similar bounds on the derivatives. The deviation is small when there are many phase-shifts available, all of them definitely smaller than pi/2. For a static potential these conditions can be met for high energies. Author

N71-19992# Michigan Univ., Ann Arbor.
DETECTION OF SINGLE QUANTIZED VORTEX LINES IN ROTATING LIQUID HELIUM
Richard Erwin Packard (Ph.D. Thesis) 1969 79 p refs
(TID-25595) Avail: NTIS

The appearance of individual quantized vortex lines was detected in liquid He 2 in narrow (approximately 1 mm) diameter, rotating, cylindrical vessels which were slowly accelerated from rest. The angular velocities where the lines appear are qualitatively consistent with theory, based upon minimization of the free energy. However, it was found that the detailed behavior of the He 2 is quite history-dependent and cannot be uniquely determined from existing theory. The detection technique involves trapping electrons on the vortex lines for a fixed length of time. A subsequent measurement of the amount of charge trapped provides an indication of the number of vortex lines present. In order to detect the small amount of charge trapped on a single line, the trapped electrons were injected through the meniscus and a proportional counter was developed to detect them in the vapor. Vortex lines were observed that persist after stopping rotation. The apparent destruction of vortices by mechanically disturbing the rotating container was also observed. Author (NSA)

N71-19993# Washington Univ., Seattle. Dept. of Physics.
MULTIPARTICLE RELATIVISTIC K-MATRIX EQUATIONS AND UNITARITY
Jan W. Dash and A. Pignotti Mar. 1970 35 p refs Sponsored by AEC and NSF
(RLO-1388-579) Avail: NTIS

An extension of the work of Baker and Blankenbecler is presented in which 2 to 2, 2 to n and m to n particle amplitudes satisfy unitarity, including both elastic and inelastic terms. Disconnected parts of the m to n amplitudes are, however, not included. Dynamical applications of the model to the unitarization of meromorphic Born terms are briefly discussed. In particular, pole degeneracies are shown to be broken and factorization of output resonance poles is proved. Author (NSA)

N71-19994# Washington Univ., Seattle. Dept. of Physics.
ASYMPTOTIC SINGLE PARTICLE DISTRIBUTIONS IN THE MULTIPERIPHERAL MODEL
N. F. Bali, A. Pignotti, and David Steele Jun. 1970 27 p refs Sponsored by AEC and NSF
(RLO-1388-585) Avail: NTIS

The conjectures of Feynman and Benecke, Chou, Yang and Yen on the high energy limit of single particle distributions are studied in the framework of the multiperipheral model. It is found that classes of multiperipheral diagrams seem to give limiting single particle distributions; pionization is present and is responsible for the logarithmic growth of the multiplicity with the energy. Author (NSA)

N71-20003# California Inst. of Tech., Pasadena. Div. of Chemistry and Chemical Engineering.
CHEMICAL REACTIONS INDUCED BY ULTRAVIOLET AND IONIZING RADIATION Final Report, 1 Nov. 1969 - 31 Oct. 1970
George S. Hammond Nov. 1970 16 p refs
(Contract F44620-70-C-0025)
(AD-716589; AFOSR-70-2755TR) Avail: NTIS CSCL 7/5

Briefly discussed is research done in four areas: (1) special acceleration of nonradiative decay of excited states by specific quenchers, (2) photochemistry of bichromophoric compounds, (3) magnetic resonance studies, and (4) high energy radiation chemistry The results in 1 and 2 have led to discovery of some interesting new photochemistry and to very tentative models as to the nature of the interactions in weakly coupled systems. Magnetic resonance work has been centered on two subjects. The rates of decay of various free radicals produced photochemically were observed. The kinetics depend on the solvent medium and indicate that solvent relaxation processes may make important contributions to variations in the rates of fast reactions in fluid media. Also studied were radicals by observing chemically induced polarization of nuclear spins (CIDNP) in reaction products. A careful study was done on the radiation induced dimerization of 1,3-cyclohexadiene, and it is believed that separation of excited state and ionic paths has been accomplished. Author (GRA)

N71-20004# Tufts Univ., Medford, Mass. Dept. of Chemistry.
INORGANIC APPLICATIONS OF NUCLEAR QUADRUPOLE RESONANCE SPECTROSCOPY Final Report
Terry E. Haas Mar. 1970 13 p refs
(Grant AF-AFOSR-859-67)
(AD-716623; AFOSR-70-2720TR) Avail: NTIS CSCL 7/2

The most important single conclusion to be drawn from this work on inorganic applications of nuclear quadrupole resonance spectroscopy is that the technique is experimentally too unreliable to allow the wise commitment of a research effort to only that technique. It is strongly felt and demonstrated, that NQR can be a particularly powerful tool in the unraveling of certain questions of electronic and molecular structure. Nevertheless there are many instances in which an expected resonance has simply not been observed, thus rendering even the best of ideas usefull for lack of evidence. This is particularly true of the boron compounds related to boron high temperature polymers which were the primary area of relevance of this effort to Air Force technical requirements. Author (GRA)

N71-20005# Montpellier Univ. (France). Dept. de Physique Mathematique.
MULTIPION PRODUCTION IN POSITRON ELECTRON COLLISIONS
J. Layssac and F. M. Renard Dec. 1970 11 p refs
(PM/70/4) Avail: NTIS

The cross sections for positron electron yields 4 and 5 pions are calculated from the contributions of the tails of the rho, omega, and phi mesons. They appear to be respectively (2 to 0.8) $\times$ 10 to the minus 32nd power sq cm in the range total E = 1 to 2 GeV and (0.09 to 0.06) $\times$ 10 to the minus 32nd power sq cm in the range total E = 1.5 to 2 GeV. Author

N71-20017# Avco-Everett Research Lab., Everett, Mass.
EXCITATION MECHANISM FOR THE O2 SCHUMANN-RUNGE SYSTEM
Ramesh O. Sharma and Kurt L. Wray Nov. 1970 38 p refs Submitted for publication
(Contract F04701-70-C-0128; ARPA Order 1092)
(AD-715995; AERL-RR-352; SAMSO-TR-70-254) Avail: NTIS CSCL 7/4

The Schumann-Runge band system of O2 involving transitions between the X triplet Sigma (g)(-) ground state and the B triplet Sigma(u)(-) excited state has been the subject of many investigations which have shown that the radiating state is strongly coupled to the O-atoms and that the population mechanism is very fast. In the present study, the emitted radiation was monitored with filter-photomultiplier combinations as a function of time behind incident shock waves in O2, O2-Ar, and O2-Ne mixtures at wavelengths centered at 2300 and 3250 A. Initial pressures in the shock tube were 1 to 100 torr and the (equilibrium) temperature range was 2800 to 5300K. The results are in disagreement with the results of Myers and Bartle both in apparent activation energy and absolute magnitude. Various other excitation mechanisms were considered and it was shown that inverse predissociation is the only one which fits the data and that it must dominate over a very wide range of conditions. Author (GRA)

N71-20028# Paris Univ., Orsay (France). Lab. de Physique Theorique et Particules Elementaires.
DUAL MODELS AND LARGE ANGLE SCATTERING
A. Krzywicki 3 Dec. 1970 9 p refs
(Rept-70/44) Avail: NTIS

A simple relationship is described, for a wide class of dual models, between the fixed momentum transfer and fixed angle asymptotic, high energy behavior. Some of the implications of the results for the phenomenology of large angle scattering are discussed. Author

N71-20030# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
RELATIVISTIC S = 1/2 SPIN ROTATION IN COLLISIONS OF PARTICLES MOVING ARBITRARILY RELATIVE TO THE OBSERVER
B. M. Golovin and V. I. Nikanorov 1970 25 p refs In RUSSIAN; ENGLISH summary
(JINR-P2-5272) Avail: AEC Depository Libraries

A relativistic rotation of S=1/2 spin of particles, taking part in a binary reaction at an arbitrary motion of colliding particles, are considered using the Lobachevsky geometry. It is shown that in the general case the relativistic spin rotation is necessary to be taken into account not only in a final, but also in an initial state of a system. Author (NSA)

N71-20032# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.
ROTATIONAL ONE PARTICLE EXCITATIONS IN THE MODEL OF NONAXIAL ODD NUCLEUS WITH ALLOWANCE FOR ITS DEFORMABILITY
I. E. Kashuba and A. A. Golubova 1970 44 p refs In RUSSIAN
(ITF-70-47) Avail: AEC Depository Libraries

Within the framework of the model of the nonaxial odd nucleus developed earlier by Davydov, Sardaryan, and Pashkevish, the low-energy spectrum of the excited states of odd nuclei with spins of the ground states equal to 7/2 and 9/2 is considered. In this case, nonadiabatics with respect to the beta vibrations of nuclear surface are taken into account. The results of the numerical calculations of the wave functions and the energies of the excited states are given in the form of tables and graphs, respectively. The calculated energies of excitations are compared with the experimental values for the nuclei Lu-177 and Ta-181 Author (NSA)

N71-20034# Joint Inst. for Nuclear Research, Dubna (USSR).
THEORY OF THE RESONANCE SCATTERING IN THE PRESENCE OF OVERLAPPING LEVELS WITH THE IDENTICAL CONSERVED QUANTUM NUMBERS
V. L. Lyuboshits 1970 14 p refs In RUSSIAN
(JINR-P2-5328) Avail: AEC Depository Libraries

With the notion of nonorthogonality of the quasi-stationary states with identical conserved inner quantum numbers as a basis, the generalized Breit–Wigner formula is discussed for the amplitude of the resonance multichannel scattering in the presence of some overlapping levels. Author (NSA)

N71-20035# Sandia Corp., Albuquerque, N.Mex.
SIMPLE METHOD OF CALCULATING NEUTRAL PARTICLE TRANSPORT PROPERTIES USING THE DISPERSION POTENTIAL
R. L. Fox and R. S. Bernard Dec. 1970 28 p Sponsored by AEC
(SC-RR-70-664) Avail: NTIS

A method is presented for estimating all of the neutral particle transport coefficients required for flow field calculations. A dispersion potential is utilized for both polar and nonpolar interactions. Expressions for the transport coefficients in terms of mean square molecular radii are developed. A method of estimating the mean square molecular radii for both monatomic and polyatomic gases is given. Results obtained using this method are compared to experimental data and to results obtained using a more complicated potential. Transport coefficients obtained using this method agree with previous values to within a factor of two for all cases considered. Author (NSA)

N71-20036# Washington Univ., Seattle. Dept. of Physics.
DIVERGENT REGGE HELICITY SUMS, DISTRIBUTIONS, AND TOLLER ANGLES
Jan. W. Dash Aug. 1970 21 p refs Supported by AEC
(RLO-1388-590) Avail: NTIS

Divergent infinite helicity sums appearing in complex J continuations of multiparticle unitarity equations including the Faddeev equations, and in the multi-Froissart-Gribov formalism are made convergent by regarding the amplitude as a distribution in the Toller azimuthal angles conjugate to the helicites. Some aspects of dynamical calculations using this formalism are discussed. Author (NSA)

N71-20037# Washington Univ., Seattle. Dept. of Physics.
MULTIPERIPHERAL NONFACTORIZATION, SIGNATURE, AND TOLLER ANGLE VARIABLE CUTS
Jan. W. Dash Aug. 1970 30 p refs Supported by AEC
(RLO-1388-591) Avail: NTIS

It is shown that the assumption of a multi-Froissart-Gribov definition of signature for multiparticle amplitudes coupled with the existence of discontinuities of internal Regge residue coupling functions in Toller angle variables in general gives rise to a non-factorizable expression for the asymptotic behavior of the full amplitude, even when the signatured amplitudes factorize. Factorizability occurs only in certain exceptional cases, including strict exchange degeneracy. The formalism can be cast into a two vector form, however, which does factorize in a matrix sense. Chew-Goldberger-Low type equations thus became 2 × 2 matrix equations in general. Author (NSA)

N71-20038# Rochester Univ., N.Y. Dept. of Physics and Astronomy.
SUPERCONDUCTIVITY AND THE ELECTRON-PHONON INTERACTION IN TRANSITION METALS
K. H. Benneman and J. W. Garland 14 Dec. 1970 14 p refs Sponsored in part by AEC Prepared in cooperation with ANL
(Contract N00014-67-A-0398-0004)

(AD-716028) Avail: NTIS CSCL 20/3

Phonon-induced intraband d to d electron scattering is shown to be primarily responsible for superconductivity in transition metals. This differs from Hopfields theory, according to which phonon-induced d to d electron scattering is unimportant. A formula is given for the superconducting transition temperature Tc as a function of measurable normal-state quantities and an effective bare electron-ion potential. The formula describes the qualitative variation of Tc among transition metals and yields quantitative values of Tc for alloys, given Tc for the constituent elements. Author (GRA)

N71-20039# Pittsburgh Univ., Pa. Dept. of Physics.

SCALE INVARIANCE AND SHORT DISTANCE BEHAVIOR IN A SIMPLE MODEL

B. Schroer Aug. 1970 17 p refs Presented at the conf. on Spec. Topics in Quantum Field Theory, St. Louis, 27 – 31 Jul. 1970

(Contract AT(30-1)-3829)

(NYO-3829-56; CONF-700710-2) Avail: NTIS

Two soluble two dimensional models are considered for the relation between the scaling group of the zero mass limit of a massive theory and the short distance behavior of vacuum expectation values. These models are the derivative coupling model and the Thirring model. NSA

N71-20040*# Virginia Univ., Charlottesville. Research Labs. for the Engineering Sciences.

RESEARCH IN THE FIELD OF MOLECULAR COLLISION PHENOMENA USING MOLECULAR BEAM TECHNIQUES Final Report

S. S. Fisher, A. R. Kuhlthau, and J. E. Scott, Jr. Feb. 1971 22 p refs

(Grant NGR-47-005-046)

(NASA-CR-117041; AEEP-4038-115-714) Avail: NTIS CSCL 20H

The application of modern molecular beam techniques to the study of molecular collision processes is reported. Emphasis has been placed on interactions between atmospheric gases and solid surfaces. Investigations have been primarily experimental observations of the scattering of gases from engineering surfaces in the thermal range of interaction energies. Aerodynamic-type molecular beams are employed. After a beam is scattered from a test surface, the angular distribution of beam flux and the distribution of velocities in that flux are measured. These distributions then characterize the interaction. Author

N71-20041# Los Alamos Scientific Lab., N.Mex.

LOS ALAMOS LAMB SHIFT POLARIZED ION SOURCE: A USER'S GUIDE

Gerald G. Ohlsen Feb. 1970 22 p refs

(Contract W-7405-eng-36)

(LA-4451) Avail: NTIS

The physical and engineering information needed to effectively utilize the polarized ion source is presented. In some instances, LASL techniques are compared with others; in other instances, the discussion is applicable to all polarized ion source types. Author (NSA)

N71-20042# Oak Ridge National Lab., Tenn. Neutron Physics Div.

ENERGY DEPOSITION BY 45 GeV PHOTONS IN Be and Al

R. G. Alsmiller, Jr. and H. S. Moran Nov. 1970 7 p refs

(Contract W-7405-eng-26)

(ORNL-4631) Avail: NTIS

Electron photon cascade calculations have been carried out for zero-width beams of 45-GeV photons normally incident on semi-infinite slabs of beryllium and aluminum, and the energy deposition is given as a function of both depth and radius in the slabs. Author (NSA)

N71-20043# California Univ., Riverside.

HADRON SPECTROSCOPY AND HIGH ENERGY SCATTERING IN THE QUARK MODEL

Petr Chylek (Ph.D. Thesis) Mar. 1970 89 p refs

(UCR-34-P-107-113) Avail: NTIS

The Roper resonance is interpreted as a radially excited three-quark state. For its octet counterparts the resonances sigma(1700), lambda(1745) and Xi(1930) are suggested. Thus, the unusually large widths of these resonances are explained and the spin-parity is predicted to 1/2(+). The quark model numerical selection rule for three hadron vertex is derived and a new graphical approach to high energy scattering in the framework of the quark model is suggested. The method is applied to elastic forward meson-nucleon scattering and several reasonably well satisfied relations between total cross sections are derived. The same model is applied to backward meson –nucleon scattering and backward N resonance sub 33 production. The model also gives a connection between the possible violation of the Pomeranchuk theorem and isospin dependence of total cross sections at high energy. Author (NSA)

N71-20044# Western Washington State Coll., Bellingham.

FISSION STUDIES ON ELEMENTS BELOW POLONIUM Progress Report, 1 Jul. 1969 –30 Jun. 1970

Edward F. Neuzil [1969] 10 p refs

(Contract AT(45-1)-1759)

(RLO-1759-23) Avail: NTIS

Fission studies on elements below polonium are reported. The effect of angular momentum on fission is being studied through fission reactions creating the same compound nucleus at the same excitation energy but induced by different particles. Some results for Pb207(alpha,f), Bi-209(d,f), Au-197(d,f) and Pt-195(alpha,f) reactions are presented. In addition some results for Ta-181(alpha,f) reactions are given. NSA

N71-20045# Cornell Univ., New York. Lab. of Atomic and Solid State Physics.

FAR-INFRARED PROPERTIES OF LATTICE RESONANT MODES. 5: SECOND ORDER STARK EFFECT

B. P. Clayman (Simon Fraser Univ.), R. D. Kirby, and A. J. Sievers Aug. 1970 65 p refs

(Contract AT(30-1)-2391)

(NYO-2391-119; MSC-1443) Avail: NTIS

Small electric field-induced frequency shifts have been observed for resonant modes associated with three defect systems. For NaI:Cl(–), the shifts have been used to measure the quartic anharmonic terms of the interionic potential of the impurity ion. For KBr:Li(+) the quartic anharmonic terms are found to be very small and a harmonic potential which includes a central barrier with the barrier height less than the zero point energy of the oscillator is required to explain the experimental results. For NaCl:Cu(+) only an on-center resonant mode configuration is consistent with the experimental results. Author (NSA)

N71-20048# California Univ., Berkeley. Lawrence Radiation Lab. Nuclear Chemistry Div.

NUCLEAR CHEMISTRY DIVISION Annual Report, 1969

Norman Edelstein, David Hendrie, and Maynard Michel, eds. Jan. 1970 411 p refs

(Contract W-7405-eng-48)

(UCRL-19530) Avail: NTIS HC$6.00/MF$0.95

The research for this period is reported. The activities presented include the following areas: physical and inorganic chemistry, X-ray crystallography, radiation chemistry, atomic, molecular, and photoelectric spectroscopy, nuclear reactions, and nuclear spectroscopy. F.O.S.

N71-20072# Tokyo Univ. of Education (Japan). Dept. of Physics.

COMMENTS ON QUANTUM FIELD THEORY OF TACHYONS

Koichi Kamoi and Susumu Kamefuchi 1970 30 p refs
(TUEP-70-31) Avail: NTIS

The problem of tachyons is investigated within the framework of quantum field theory. The quantization methods for a free scalar tachyon field, which have so far been proposed by various authors, are critically reviewed. Among them the Arons-Sudarshan method is found to be most satisfactory, which guarantees at least relativistic covariance of the theory at the expense of locality and reasonable energy spectrum. On the basis of this method, interactions of a tachyon field are investigated. It is found that causal S-matrices do not exist as far as interaction terms are restricted to the ordinary, local-polynomial type. A model S-matrix, which is unitary but not causal, is then assumed, and the reinterpretation principle is applied to it in order to remove states of negative-energy tachyons. It is found that the reinterpreted S-matrix thus obtained is not consistent with unitarity. Author

N71-20074# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
MATTER-ANTIMATTER HYDRODYNAMICS
R. Omnes Nov. 1970 33 p refs Submitted for publication
(Rept-70/38) Avail: NTIS

The hydrodynamics of matter and antimatter in contact is studied. Hydrostatics is studied in detail and it is found that static equilibrium is in general impossible. More evidence is given for the eixistence of the coalescence effect, which does not amount yet to a rigorous proof. Author

N71-20075# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
DECISIVE TESTS FOR DIP MECHANISMS
J. Tran Thanh Van 1970 9 p refs
(Rept-70/46) Avail: NTIS

Some decisive tests for the dip mechanisms are proposed: measurements of density matrix elements of positive pion neutron yields (1) proton and positive pion yields omega-meson delat-hyperon (++), and forward behavior of differential cross section of eta-meson production. Available data are in disagreement with the simple Dar-Harari picture, and in favor of the weak cut model. Author

N71-20078# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires.
STUDY OF AXIAL INJECTION OF POLARIZED PROTONS INTO THE GRENOBLE CYCLOTRON [CONTRIBUTION A L'ETUDE DE L'INJECTION AXIALE POUR PROTONS POLARISES SUR LE CYCLOTRON DE GRENOBLE]
Jean-Louis Pabot (Ph.D. Thesis - Grenoble Univ.) 1969 103 p In FRENCH
(CEA-R-3729) Avail: AEC Depository Libraries

By injecting ions axially into a cyclotron, it is possible to accelerate particles (polarized particles, heavy ions, etc.) obtainable only with difficulty when an internal ion source is used. After justifying the choice of an axial injection device equipped with pseudo-cylindrical deflector for the Grenoble cyclotron, the principal of such a deflector, the choice of its paramters, and the effect of this choice on the conditions of acceleration of the beam by the cyclotron are studied. Two operations are described which made it possible to check that the chosen injection device operated satisfactorily: qualitatively initially (electron model), then quantitatively (proton model). In conclusion, it is believed that the Grenoble cyclotron thus equipped will be able to provide a relatively dense beam of polarized protons. Author (NSA)

N71-20079# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
STUDY OF THE ARTIFICIAL RADIOACTIVITY OF THE MARINE MEDIUM USING GAMMA SPECTROMETRY (1962-1964) [ETUDE DE LA RADIOACTIVITE ARTIFICIELLE DU MILIEU MARIN PAR SPECTROMETRIE GAMMA]
Roger Chesselet (Ph.D. Thesis - Paris Univ.) 1969 117 p refs In FRENCH
(CEA-R-3696) Avail: AEC Depository Libraries

The radioactivity of Ce-141, Ce-144, Nb-95, Pr-103, Ru-106, and Zr-95 present in atmospheric fallout between 1962 and 1964 and their incidence in superficial marine waters were studied. Physical, chemical, and biological processes were studied using gamma ray spectrometry. Accumulation in the planktonic biomass and diffusion toward deeper waters were controlled by the quantity of radioactive particles in the soluble phase in seawater. A spectrometry method is described which allows direct measurement the sea of very low concentrations of some gamma ray emitters. The application of the method made it possible to carry out numerous observations in the surface waters of the Western Mediterranean sea and in the Bay of Biscay. It was shown that the mixing depth was closely connected to the depth of the thermocline. A comparative study showed that the rate of radioactive fallout on the maritime zone was always two to three times higher than on neighboring continental regions. Explanations of this phenomenon are discussed. Author (NSA)

N71-20081# Gosudarstvennyi Komitet po Ispolzova Niyu Atomnoi Energii, Serpukhov (USSR). Institut Fiziki Vysokikh Energii.
INVESTIGATION OF THE DEPENDENCE OF THE SPARK BRIGHTNESS OF IONIZATION IN THE RANGE OF 1 < or = I/I MIN < or = 15 AT P = 1 atm, 0.3 atm, 0.1 atm
V. N. Bolotov, G. A. Bydanov, M. N. Devisheva, M. I. Devishev, O. I. Michailov et al 1969 32 p refs In RUSSIAN
(IFVE-SEF-69-72) Avail: AEC Depository Libraries

The spark brightness was studied in a wide range of ionization bases at P = 0.1 atm, 0.3 atm and 1 atm. It is shown, that: (1) dependence of the brigthness on the ionization is of logarithmical characters at various pressures; (2) the range and the degree of the brightness dependence on ionisation is determined by the choice of the operational mode of the chamber high voltage supply; and (3) the distribution of the ionization losses, measured experimentally with respect to the spark brightness, coincides for the particles with the same energy. Author (NSA)

N71-20104# Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes Nucleaires.
DESCRIPTION OF A MULTIMODE GAMMA SPECTROMETER [DESCRIPTION D'UN SPECTROMETRE GAMMA MULTIMODE]
Joeel Chardine, Gerard Haoust, Claude Humeau, Jean Lachkar, Jean Sigaud et al Feb. 1969 47 p refs In FRENCH
(CEA-R-3747) Avail: AEC Depository Libraries

A multimode gamma spectrometer known as the SGMM 10 is described. It can detect photons by one of three different modes: total absorption, photoelectric and anti-Compton effect, or the pair effect. These results are recorded in such a way that the experimenter can interpret the measurements according to the mode which is the best adapted to the energy of the photons under study. The instrument is made up of a central detector, a Ge(Li) semiconductor with its cryostat, and an annular crystal, and a large volume NaI(Ti) scintillator consisting of four optically isolated sectors. The energy and time data produced by these detectors are processed by an electronic unit. Author (NSA)

N71-20105# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
DISLOCATIONS AND RADIATION DAMAGE IN ALPHA-URANIUM [DISLOCATIONS ET EFFETS DES RADIATIONS DANS L'URANIUM]
Jean Leteurtre (Ph.D. Thesis - Paris Univ.) 1969 147 p refs In FRENCH

(CEA-R-3607) Avail: AEC Depository Libraries

Dislocations in alpha-uranium were studied by electron microscopy. Electropolishing thin foils was preformed at (−110 C) to prevent oxidation. Burgers vectors of twin dislocations were defined. Interactions between slip and twinning were studied experimentally and theoretically. Samples irradiated at various burnup levels were examined. In order to explain the micrographic results and informations gathered in literature about radiation damage in alpha-uranium, a coherent model was proposed for the fission particle effects. The influences of temperature, dislocation density, and impurity content were examined. The number of point defects created by one initial fission was determined for pure and annealed metal. The importance of self-anneal which occurs immediately in each displacement spike and the anneal due to a new fission on the damage resulting from a previous fission are estimated. The focusing distance in (100) direction is found to be about 1000 A, at 4 K. Author (NSA)

N71-20122# Joint Inst. for Nuclear Research, Dubna (USSR).

RELATIVISTIC PHASE-SPACE VOLUMES FOR THE ANGULAR PION NUCLEON CORRELATIONS IN THE REACTION NUCLEON + NUCLEON YIELDS NUCLEON + PION

V. C. Suslenko 1970 27 p In RUSSIAN

(JINR-P2-4917) Avail: AEC Depository Libraries

The relativistic expressions for the angular pion N correlation phase-space volumes for the final state of the reaction N + N → N + N + pion were derived for a number of reference systems. These expressions are necessary to extract from experimental correlation data information relating to the square matrix element as a function of all independent invariants describing this reaction. In connection with this problem the necessary requirements to the experimental procedure are discussed. Author (NSA)

N71-20171# Joint Inst. for Nuclear Research, Dubna (USSR).

SEARCH FOR ISOBAR WITH ISOTOPIC SPIN T = 5/2 IN THE REACTION PION(+) + p YIELDS PION(−) + X(3 +)

V. K. Birulev, A. S. Vovenko, and B. N. Guskov 1970 11 p refs

(JINR-P1-5059) Avail: AEC Depository Libraries

The spectrum of negative pions was measured in the reaction positive pion + proton yields negative pion + X(3+) at the positive pion meson momentum of 3.88 GeV/c and the negative pion meson emission angle of 1.9 deg. In the obtained spectrum the maximum was observed which can be explained by kinetic effect of the coproduction of delta (2+) hyperon (1.24) isobar and neutral rho meson. Within the experimental errors the production of the isobar with the isotopic spin T = 5/2 in the mass range from 1.2 to 2.2 GeV/c squared was not observed. Statistically unjustified deflection from the smooth theoretical curve in the mass region of 1.5 to 1.7 GeV/c squared can be observed. Author (NSA)

N71-20188# Joint Inst. for Nuclear Research, Dubna (USSR).

PROBLEM OF ELEMENTARY PARTICLE IDENTITY

V. L. Lyuboshits and M. I. Podgoretskii 1970 21 p refs In RUSSIAN; ENGLISH summary

(JINR-P2-5063) Avail: AEC Depository Libraries

A problem of continuous transition between the properties of systems of identical and nonidentical particles was considered. It is shown that in the presence of degeneration on some inner quantum number the degree of nonorthogonality of corresponding superpositions is a continuous parameter of such a transition. A logically possible scheme is described in the framework of which the identity of particles is approximate. Author (NSA)

N71-20189# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

THE 3,55 GeV/c Kp ELASTIC SCATTERING NEAR 180 DEG [DIFFUSION ELASTIQUE DES K DE 3,55 GeV/C PAR LES PROTONS, AU VOISINAGE DE 180 DEG]

Jean Duflo (Ph.D. Thesis − Paris Univ., 1968) 1969 104 p refs In FRENCH

(CEA-R-3685) Avail: AEC Depository Libraries

Backward elastic positive kaon proton and negative kaon proton scattering was measured in the angular interval 168 deg less than zero cm less than 177 deg. The experimental apparatus included optical spark chambers to measure the three prongs of the event scattering, a set of scintillation counters and Cerenkov counters to select events and trigger chambers, and a magnet to determine the moment of the recoil proton. There were 106,000 photographs taken. Of these, 22 satisfied all requirements as elastic positive kaon proton scattering events. No event was found to satisfy the kinematical criteria for negative kaon proton elastic scattering. Contaminations by pion proton backward scattering and inelastic scattering were estimated. Elastic scattering positive kaon + proton exhibits a backward peak. A reasonably satisfactory interpretation of the results is obtained by exchange models. The results lend support to the conclusions of the interference model developed previously for pion proton backward scattering, and to qualitative previsions of the quark model. Author (NSA)

N71-20190# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.

APPLICATION OF THE STURM-LIOUVILLE FUNCTIONS FOR SOLUTION OF THE SCHROEDINGER EQUATION WITH THE ANISOTROPIC SAXON-WOODS POTENTIAL

F. A. Gareev, S. P. Ivanova, and N. Yu. Shirikova 1970 20 p refs In RUSSIAN

(JINR-P4-5351) Avail: AEC Depository Libraries

A method is suggested for solution of the Schroedinger equation with anisotropic potential of finite depth for bound states E < 0. A single-particle wave function is represented as a superposition of the wave eigenfunction of the Sturm−Liouville problem. The problem of taking into account the effect of the continuous spectrum on the bound states is solved automatically. Author (NSA)

N71-20194*# Grumman Aircraft Engineering Corp., Bethpage, N.Y.

SCATTERING OF EPITHERMAL ARGON BY (III) SILVER SURFACES: A COMPARISON OF THEORY AND EXPERIMENT

V. S. Calia and R. A. Oman Sep. 1969 44 p refs

(Contract NASw-1461)

(NASA-CR-117180; RE-371) Avail: NTIS CSCL 20H

Scattering distributions have been measured for Ar incident on fresh epitaxial Ag films. For several incidence angles, energies of one and two eV were supplied by a shock tube driven nozzle beam. Scattered density profiles in the plane of incidence and 30 deg out-of-plane agree very well in magnitude and direction with calculations for corresponding cases using methods previously described. No arbitrary scaling of density levels was employed. The scattering patterns are essentially unchanged for several hours at 5 × 10 to the minus 7th power torr. Peak signals are very high (> 10 times incident flux per steradian), and the small amount of excess flux near the surface normal suggests that most of the surface is atomically flat. Approximate measurements of reflected velocities agree well with predictions except between the specular and the normal, where measured velocities for the one eV case are quite low. Measurements indicate good agreement with the same theory for direction and width of reflected beam as energy varies from 0.5 to 5 eV. Author

N71-20197# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

ON THE PHASE OF THE phi-NUCLEON FORWARD SCATTERING AMPLITUDE

Margarete Krammer Oct. 1970 8 p refs
(DESY-70/53) Avail: AEC Depository Libraries

The ratio of real and imaginary parts for the phi-nucleon elastic scattering amplitude in the range 7 to 15 GeV/c was calculated to be alpha = −0.3 + or − 0.45, using the additive quark model with isospin symmetry. NSA

N71-20198# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

CHARGED PARTICLE DETECTORS MADE BY IMPLANTATION

A. Garin, M. Oria (Inst. Natl. des Sci. et Tech. Nucl., Saclay), and B. Waast 1970 5 p Presented at the Intern. Conf. on Ion Implantation in Semiconductors, Thousand Oaks, Calif., 4–7 May 1970
(CEA-CONF-1642; CONF-700544-1) Avail: AEC Depository Libraries

Ion implantation was considered as a way of doping detectors. The possibilities of implanting phosphorus and boron ions in silicon for dE/dx and localization detectors and lithium ions for deep E detectors were studied. It is possible to make thick NIP detectors which have neither front nor back windows and which can be stacked for measuring particles of very high energy. NSA

N71-20199# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

THE RATE OF DISINTEGRATION OF NUCLIDES PRODUCED BY THE THERMAL FISSION OF U 235 AND Pu 239 AND BY THE FAST FISSION (E APPROXIMATELY = TO 1 MeV) OF U 235, U 238 and Pu239 [TAUX DE DESINTEGRATION DES NUCLEIDES PRODUITS PAR UNE FISSION THERMIQUE DE U 235 ET PU 239, ET PAR UNE FISSION RAPIDE (E APPROXIMATELY 1 MEV) DE U 235, U 238, ET PU 239]

Bertrand Barre and Roland De Tourreil Oct. 1970 32 p refs In FRENCH
(CEA-N-1370) Avail: AEC Depository Libraries

The total activity per second of the products from the thermal fission of U-235 and Pu-239 and the fast fission of U-235, U-238, and Pu-239 is given for several cooling times between 1 and (5 × 10 to the 8th power) sec; the contributions of the principal active nuclei to this activity are also given. Author (NSA)

N71-20212# National Bureau of Standards, Washington, D.C. Heat Div.

NBS RADIOMETRIC STANDARDS: PRESENT AND FUTURE

Henry J. Kostkowski *In its* Space Simulation Oct. 1970 p 185–187 refs (See N71-20201 09-11)
Avail: SOD $5.25

In radiometry, the currently available standards consist of various types of tungsten lamps or blackbodies that have been calibrated in terms of spectral radiance, spectral irradiance or total irradiance. The standards of spectral radiance are either tungsten strip lamps or blackbodies, have temperatures from 500 K to 3000 K, and are calibrated, depending on the temperature and source, from 0.2 micrometer to 15 micrometer. Two additional, useful standards that do not require calibration and are available commercially are the graphite arc and the copper-point blackbody. Author

N71-20221# Office National d'Etudes et de Recherches Aerospatiales, Toulouse (France).

RELATION BETWEEN DOSE RATE EFFECTS AND LABORATORY SIMULATION OF SPACE RADIATION DAMAGE

A. Roizes and R. Schuttler (Inst. Natl. des Sci. App., Toulouse, France) *In* NBS Space Simulation Oct. 1970 p 313–321 refs (See N71-20201 09-11)
Avail: SOD $5.25

The experimental simulation of space radiation damage with defect annealing in the semiconductor can lead to an overestimation of the real space degradation; the irradiation time can be of the same magnitude order than the annealing time constant. The higher density of punctual defects introduced by a greater flux rate enhances the production of multiple defects and reduces the production of vacancy-impurity complexes. Different factors that influence the defect center distribution are analyzed in the range −100 C to +100 C. It is shown that the production rate of defects in the bulk material depends on the impurity constant. Author

N71-20223*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ULTRAVIOLET AND CHARGED PARTICLE DEGRADATION OF ALUMINUM AND SILVER COATED FEP TEFLON SECOND SURFACE MIRRORS

F. G. Cunningham, B. L. Bean, and S. G. Park *In* NBS Space Simulation Oct. 1970 p 345–358 refs (See N71-20201 09-11)
(NASA-TM-X-66939) Avail: NTIS; SOD $5.25 CSCL 20H

FEP Teflon films were subjected to ultraviolet irradiation and charged particle bombardment, and five mil aluminum and silver coated FEP Teflon films were: (1) exposed to ultraviolet irradiation in vacuum and oxygen; (2) irradiated with 5, 10 and 25 or 30 KeV electrons and protons; and (3) exposed to simultaneous ultraviolet-proton and ultraviolet-electron bombardment. The charged particle irradiations indicate that a measurable change occurs in the spectral reflectance of both silver and aluminum backed material at a dose of about 1 x 10 to the 15th power particles/sq cm, and that this degradation increases as the total dose is increased. Surface mottling is found to be due to the presence of Litchenberg figures within the Teflon. The ultraviolet results confirm that silver coated Teflon is stable when irradiated in vacuum and indicate that aluminum coated material undergoes a small decrease in integrated solar absorptance. Author

N71-20224*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE INTERACTION OF LOW ENERGY ELECTRONS WITH POLYMERIC PERFLUORINATED ENTHYLENEPROPYLENE (FEP)

John B. Schutt *In* NBS Space Simulation Oct. 1970 p 359–382 refs (See N71-20201 09-11)
(NASA-TM-X-66940) Avail: NTIS; SOD $5.25 CSCL 20H

Photomicrographs are presented showing the effects of 30 Kev electrons on FEP. Depicted are Lichtenberg patterns, bubbles and a buckling effect. These effects are discussed in terms of an electrolysis mechanism resulting from charge storage and beam energy thermalization. Explicit expressions are given for surface charge storage and voltage across the sample resulting from such charge accumulation. Buckling is treated from a thermodynamic basis using the Helmholtz free energy and assuming the distortion develops isothermally. Electrolysis is postulated via a mechanism selecting the tertiary carbon as the active site for mobile moiety generation. Author

N71-20233# Gulf Energy and Environmental Systems, Inc., San Diego, Calif. Defense Sciences Div.

CHARGED PARTICLE TRACK IMPLICATIONS FOR ACCELERATED TESTING

T. M. Flanagan and V. A. J. van Lint *In* NBS Space Simulation Oct. 1970 p 525–534 refs (See N71-20201 09-11)
Avail: SOD $5.25

The particle track through a material is visualized as a cylinder centered on the particle path disturbed by ionization and carrier trapping. The dimension of the disturbed region is related to the range of the electron ejected by the ionization event, while

the density of carriers within the disturbance depends on the ejected electron range and on the ionization efficiency of the energetic particle. The dose-rate dependence arises from the relationship of the characteristic relaxation times and the average time for two particles to disturb the same volume. The size of the disturbance around a track varies from 100 to about 2000 A, depending on the material. This quantity can be used to calculate the average overlap time for a given dose rate. The dose which must accumulate before nonlinearities are apparent can be estimated from the trap density of the material. Author

N71-20296# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.

ALLOWANCE FOR THE WAVE FUNCTION DISTORTION UNDER MULTIPOLE ANALYSIS OF FAST NUCLEON SCATTERING BY NUCLEI

A. G. Sitenko, A. D. Fursa, and I. S. Dotsenko 1970 20 p refs In RUSSIAN

(ITF-70-50) Avail: AEC Depository Libraries

Allowance is made for wave-function distortion in the initial and final state within the framework of the multipole formalism in describing high-energy nucleon scattering by nuclei. The distorted optical potential is calculated on the basis of the two-nucleon interaction in accordance with the multiple scattering theory. The numerical calculations of the angular distributions are carried out for elastic scattering of protons by C-12 and also for inelastic scattering of protons by C-12 with excitation of the $0(+)$, $1(+)$, $2(+)$, and $3(-)$ levels when $T = 0$ and $1(+)$ and $2(+)$ levels when $T = 1$. A comparison with the experimental data for a proton energy of 185 MeV is carried out. The character of the angular dependence and the absolute magnitudes of the cross sections agree well in many cases with the experimental values. Author (NSA)

N71-20297# Akademiya Nauk URSR, Kiev. Inst. Teoreticheskoi Fiziki.

CONSTRUCTION OF THE CROSSING-SYMMETRICAL AMPLITUDE USING VENEZIANO-LIKE QUASIPOTENTIAL

L. L. Enkovski, V. P. Shelest, B. V. Struminskii, and G. M. Zinovev 1970 11 p refs

(ITF-70-12) Avail: AEC Depository Libraries

A method for the construction of a crossing symmetric scattering amplitude is suggested. The method is based on the quasipotential equation for the scattering amplitude. The asymptotic behavior of the scattering amplitude at high energies S approaches the limit of infinity was investigated. Author (NSA)

N71-20298# Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes.

PROBLEMS IN RADIATION HYDRODYNAMICS [PROBLEMES D'HYDRODYNAMIQUE EN PRESENCE DE RAYONNEMENT]

Jean-Louis Bobin Sep. 1970 117 p refs In FRENCH

(CEA-R-4057) Avail: AEC Depository Libraries

Basic equations describing radiation hydrodynamics are given. Methods to integrate the radiation-transfer equation over angles and frequencies are presented in some detail. Examples deal with thermal waves and radiative shock front structure. Author (NSA)

N71-20302# Joint Inst. for Nuclear Research, Dubna (USSR).

CALCULATION OF THE nd SCATTERING LENGTH WITH REALISTIC POTENTIALS

V. B. Belyaev, J. Wrzecionko, and A. L. Zubarev 1970 9 p refs In RUSSIAN

(JINR-P4-5000) Avail: AEC Depository Libraries

A system of one-dimensional Faddeev equations was obtained for the problem of nd scattering at zero energy using the separable representation of two-particle t-matrix. The calculation was performed for two realistic potentials. The obtained results are compared with experimental results. Author (NSA)

N71-20303# Stanford Research Inst., Menlo Park, Calif.

ROLE OF CURVE-CROSSINGS IN MOLECULAR COLLISIONS: ADIABATIC AND DIABATIC POTENTIAL CURVES

R. E. Olson and F. T. Smith [1970] 8 p refs Presented at Conf. on Potential Energy Surfaces in Chem., Santa Cruz, Calif. Sponsored by AEC

(SRIA-115-P-78-6; CONF-700829-1) Avail: NTIS

Elastic and inelastic scattering of ions and atoms are briefly discussed. A source of interference patterns in differential scattering is considered to be the crossing of two electronic states of the combined system, and illustrations are given for $He(+)$ Ne data. Information on the spacing of the oscillations and their amplitudes, available from the interference patterns, is described. N.E.N.

N71-20307# Rochester Univ., N.Y.

THEORY FOR THE EFFECT OF THE LOCAL ATOMIC ENVIRONMENT AND SPIN-ORBIT COUPLING ON THE FORMATION OF LOCAL MAGNETIC MOMENTS

K. H. Bennemann and J. W. Garland 14 Dec. 1970 10 p refs Sponsored in part by AEC Prepared in cooperation with ANL

(Contract N00014-67-A-0398-0004)

(AD-716031) Avail: NTIS CSCL 20/12

A theory is presented for the effects of the atomic environment on the stability of localized magnetic moments, on the temperature at which the spins of a cluster of magnetic atoms appear, order, and at which magnetic order among different magnetic clusters occurs. It is argued that the covalent splitting of the d-electron states causes the appearance and quenching of the magnetic moments in Cu:Ni and Au:V alloys. The predicted persistence of magnetic moments above the Curie temperature in Cu:Ni is supported by the electrical resistivity and photo-emission. The paper discusses also how spin-orbit coupling affects magnetic moments. Author (GRA)

N71-20308# Joint Inst. for Nuclear Research, Dubna (USSR).

REACTIONS IN COMPLETE FUSION OF NUCLEI

B. N. Kalinkin and I. Z. Petkov 1970 18 p refs In RUSSIAN

(JINR-P4-5019) Avail: AEC Depository Libraries

The process of complete fusion is discussed, taking into account the recent experimental data. The consequences ensuing from the model are considered. It is shown that investigation of the process of production of the compound nuclei can, in principle, give some information on their macroscopic characteristics, as well as on the value of the fission barrier in the conditions of strong heating up. Author (NSA)

N71-20309# Central Electricity Generating Board, Berkeley (England). Nuclear Labs.

FISP 2: THE CURRENT VERSION OF THE FISP PROGRAM FOR FISSION PRODUCT INVENTORIES

R. H. Clarke and R. E. Utting Jul. 1970 20 p refs

(RD/B/N-1737) Avail: AEC Depository Libraries

Details are presented of the new facilities which have been added to the FISP program. The additions are the following: the decay chains are extended to be up to 9 isotopes long, and the stable nuclides are included into the standard library; the stable nuclides can be activated and the daughters allowed to decay; multienergy group gamma spectra can be generated and beta heating evaluated for the inventory; macroscopic absorption data are evaluated; and inventories are more easily evaluated in the case of a reactor startup after being shutdown. These additional facilities are explained and a complete input data specification is presented together with examples of the output produced. Author (NSA

N71-20310# Atomic Energy Commission Research Establishment, Riso (Denmark).
GAMMA-RAY LOGGING BY MEANS OF THERMOLUMINESCENCE DOSIMETERS
Bjarne Leth Nielsen (Geol. Surv. of Greenland) and Vagn Mejdahl Jun. 1970 17 p refs
(RISO-219) Avail: AEC Depository Libraries

Gamma-ray logging of drill holes by means of thermoluminescence dosimeters offers an interesting alternative to conventional scintillation-detector logging. The feasibility of the method was demonstrated in a preliminary experiment carried out at Kvanefjeld in Greenland. Capsules filled with thermoluminescent CaSO4:Dy were placed at intervals of 10 cm down to a depth of 100 m and exposed for sixteen days after which they were returned to Riso for evaluation. The results were in good agreement with a log diagram obtained by means of a scintillation detector and showed close correlation with core-scanning data. Author (NSA)

N71-20311# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
HARD-PHOTON EMISSION IN POSITRON ELECTRON REACTIONS
G. Bonneau (Ph.D. Thesis) and F. Martin (Ph.D. Thesis) 1970 36 p refs
(Rept-70/42) Avail: NTIS

The radiative corrections to lowest order for the reactions e(+)e(−) giving any final state f, different of e(+)e(−), are calculated, taking into account the photons emitted by the electrons. Results are applied to the process e(+)e(−) yields pion(+)pion(−). The differing results are shown in: (1) rigorous calculation of Feynman diagrams without using the quasi-reel process approximation, (2) error in the Coulomb terms, and (3) precise evaluation of photon phase space. Author

N71-20317# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
DEUTERON ACCELERATION IN THE LHE SYNCHROPHASOTRON
G. S. Kazansky, A. I. Mikhailov, and G. P. Pychkov 1970 9 p refs In RUSSIAN
(JINR-P9-5311) Avail: AEC Depository Libraries

The basic principles are presented of the deuteron and alpha-particle acceleration in the synchrophasotron in two stages (the first stage up to 300 MeV, and the second one up to the maximum energy). The choice of the cycle of the synchrophasotron accelerating system and the peculiarities of the transition from one stage to another are described. The experimental results are given. Author (NSA)

N71-20336# Joint Inst. for Nuclear Research, Dubna (USSR).
EXPERIMENTAL DETERMINATION OF QUALITY FACTOR FOR 200 MeV PROTONS BY A SET OF IONIZATION AND SCINTILLATION DETECTORS
S. Pszona, M. Zielczynski, M. M. Komochkov, B. S. Sychev, and A. P. Cherevatenko 1970 11 p refs
(JINR-E16-5384) Avail: AEC Depository Libraries

An experimental arrangement consisting of an ionization chamber and a scintillation detector for measuring the quality factor, or depth dose distribution, of high energy protons is described. The distribution of the quality factor in a tissue equivalent slab phantom irradiated with 200 MeV proton beam was estimated. Author (NSA)

N71-20337# International Centre for Theoretical Physics, Trieste (Italy).
LECTURES ON BOUND ELECTRON PROBLEMS, CHAPTERS 1, 2, AND 3
C. Fronsdal (California Univ., Los Angeles) Oct. 1970 44 p refs Sponsored in part by AEC and UN
(IC-70/34-Ch-1-Ch-2-Ch-3) Avail: AEC Depository Libraries

The discussion of bound electron problems covers the Schroedinger theory in Lagrangian form, solutions of the unperturbed problem, transition probability, cross sections, radiation theory, first-order electromagnetic transition, Compton scattering, and Bargmann and Fock treatment of O(4) symmetry. Various topics in group theory are also considered. NSA

N71-20338# Japan Atomic Energy Research Inst., Tokyo.
PULSE PILEUP EFFECT IN NaI(Tl) DETECTOR SYSTEM
Toshiaki Sekine and Hiroshi Baba Sep. 1970 20 p refs In JAPANESE; ENGLISH summary
(JAERI-Memo-4144) Avail: AEC Depository Libraries

A method for estimating the pulse-pileup effect is presented. It is shown that the analysis can be carried out in terms of the peak-area ratio between two gamma-ray sources of the same nuclide with different intensities, measured at the same geometry. The deviation of the photopeak area by the pulse-pileup effect in a NaI(Tl) detector was estimated for the gamma ray from the Cs-137 source (0.662 MeV). The deviation was proportional to the total counting rate and the four-tenths power of the time constant of an amplifier. Author (NSA)

N71-20339# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
RECOIL EFFECTS DUE TO MASS DIFFERENCES AND THE QUARK MODEL OF DIFFRACTIVE PRODUCTION OF N(1470, 1690)
A. Le Yaouanc, L. Oliver, O. Pene, and J. C. Raynal May 1970 28 p refs Revised
(LPTHE-70/43) Avail: NTIS

Using the scalar quark-quark amplitudes and the radii of the hadrons, fitted from elastic scattering, the production of N(1470, 1690) by pion or p on protons is described. Single scattering is shown to dominate near forward production and peaks at absolute t approximately equals 0 with a slope smaller than the elastic one. The quark-quark amplitudes due to the mass difference N - p is modified. Author

N71-20374 Yale Univ., New Haven, Conn.
THE D(d,p)T REACTION WITH A POLARIZED DEUTERON BEAM
Richard Ira Steinberg (Ph.D. Thesis) 1969 169 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-2809

The vector polarization analyzing power and the tensor polarization analyzing powers of the D(d,p)T reaction have been measured at a mean deuteron energy of 140 keV using a beam of polarized deuterons from the polarized ion source and a 100-keV-thick target of unpolarized deuterated polyethylene. Outgoing protons from the reaction were observed at eight angles in each of two orthogonal reaction planes. The results for the vector analyzing power are in agreement with previous measurements at 100 and 200 keV; the tensor analyzing powers are in reasonable agreement with a previous measurement at 170 keV and are consistent with the Rook-Goldfarb treatment except for the detection of a small quintet-state contribution. Dissert. Abstr.

N71-20375 Rensselaer Polytechnic Inst., Troy, N.Y.
FISSION NEUTRON MULTIPLICITY MEASUREMENTS IN THE RESOLVABLE RESONANCE REGION
Simon Weinstein (Ph.D. Thesis) 1969 126 p
Avail: Univ. Microfilms: HC $6.20/Microfilm $3.00 Order No. 70-2657

The dependence on incident neutron energy of the fission neutron multiplicity was investigated for U-233, U-235, and Pu-239. The results of measurements for 20 resolved resonances in Pu-239 below 100 eV show that the grouping is strongly correlated with

the spins of the individual resonances; average multiplicity for the J=0 group is 2.6% higher than the average for the J=1 group. Apparent variations in fission neutron multiplicity were observed below 10 eV among the low energy resonances of both U-233 and U-235. The results in the energy region from 0.01 to 0.3 eV show that the multiplicity is independent of energy for U-233 but show a statistically significant decrease for U-235 in going from 0.3 to 0.01 eV. Dissert. Abstr.

N71-20379# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Kernphysik.

NUCLEAR SPECTROSCOPY USING RADIATIVE NEUTRON CAPTURE AND NEUTRON INDUCED FISSION

W. Michaelis Feb. 1970 30 p refs Presented at the IAEA Meeting on Res. Reaction Utilization, Rome, 2–6 Feb. 1970

(KFK-1197; CONF-700204-2) Avail: AEC Depository Libraries

Experiments at research reactors in the field of nuclear spectroscopy are sketched. This research is performed using the radiative neutron capture reaction or neutron-induced fission. Current techniques are described very briefly. The following topics are discussed: studies of configuration mixing and two-quasiparticle states in nuclei with deformed equilibrium shape, investigations of shell-model configurations in even spherical nuclei, and the search for new regions of stable deformation or shape-isomers. Future trends are discussed, and some recommendations for future activities are given. Author (NSA)

N71-20383# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

STUDY OF HETEROGENEOUS MULTIPLYING AND NON-MULTIPLYING MEDIA BY THE NEUTRON PULSED SOURCE TECHNIQUE [ETUDE DES MILIEUX HETEROGENES MULTIPLICATEURS ET NON-MULTIPLICATEURS PAR LA TECHNIQUE DE LA SOURCE PULSEE DE NEUTRONS]

Valentine Deniz (Ph.D. Thesis–Paris Univ., Orsay, France) 1969 194 p refs

(CEA-R-3640) Avail: AEC Depository Libraries

The pulsed neutron technique consists essentially in sending in the medium to be studied a short neutron pulse and in determining the asymptotic decay constant of the generated population. The variation of the decay constant as a function of the size of the medium allows the medium characteristics to be defined. This technique was applied to lattices to see if useful information could be collected for lattice calculations. A general theoretical study of the problem and results and interpretation of a series of experiments made on graphite lattices are presented. There is good agreement for non-multiplying media. In the case of multiplying media, it is shown that the age value used previously in graphite lattice calculations is overestimated by about 10%. Author (NSA)

N71-20384# Toronto Univ. (Ontario). Dept. of Chemistry.

KINETICS OF ATOMIC ASSOCIATION REACTIONS USING FLASH PHOTOLYSIS OVER A WIDE TEMPERATURE RANGE Final Scientific Report, 15 Oct. 1963–14 Oct. 1970

George Burns Nov. 1970 92 p refs

(Grants AF-AFOSR-0506-64; AF-AFOSR-0506-66; AF-AFOSR-1695-69)

(AD-716423; AFOSR-70-2752TR) Avail: NTIS CSCL 7/4

Although it proved possible in recent years to improve greatly the understanding of unimolecular reactions, much less is known about the true nature of the molecular recombinations and dissociation reactions 2 A + M = A2 + M. The objective of the present investigation was to obtain accurate rate data for such reactive systems and to use these data in order to verify (or discard) existing theories of dissociation-recombination. An important accomplishment involved the development of a high temperature flash photolysis technique fo studying Br and I atom recombination from room temperature up to 1300K in a single experiment. In order to reduce experimental data to accurate rate constants, various thermal effects, which interfered with measurements, were studied. Furthermore, recombination was also studied over an appreciable pressure range of third body, M. A variety of third bodies were used and their properties, if related to recombination reaction, were studied. Author (GRA)

N71-20386# Avco-Everett Research Lab., Everett, Mass.

ELECTRON DETACHMENT FROM F( ) ION IN A SHOCK-HEATED CESIUM FLUORIDE - ARGON MIXTURE

A. Mandl, E. W. Evans, and B. Kivel Dec. 1970 15 p refs

(Contract F04701-70-C-0128)

(AD-715994; AERL-AMP-301; SAMSO-TR-70-101) Avail: NTIS CSCL 7/4

An experimental determination has been made of the rate of electron detachment from F(-) in shock-heated mixtures of cesium fluoride and argon. The detachment rate is found to increase exponentially with temperature, indicating an activation energy comparable to the electron affinity of F(-). Author (GRA)

N71-20405# National Research Council of Canada, Ottawa (Ontario).

MESOATOMIC PROCESSES AND A MODEL OF LARGE MESIC MOLECULES (REVIEW)

S. S. Gershtein et al 1970 53 p refs Transl. into ENGLISH of the book "Mesoatomnye Protessessy i Model'Bolshikh Mezomolekul (Obzor)" Dubna, Ob'Edinennogo Inst. Yadernykh Issled., 1968 64 p Submitted for publication

(NRC-TT-1426) Avail: NTIS

The model of large mesic molecules has been successful in explaining the laws of capture of negative pions in chemical compounds. Predictions made on the basis of this model are in good agreement with experiments on the capture of negative pions in various hydrogen containing substances. Author

N71-20414 Stanford Univ., Calif.

QUASIELASTIC SCATTERING FROM CALCIUM 40 AND CALCIUM 48

Peter David Zimmerman (Ph.D. Thesis) 1969 145 p

Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 70-1635

Corrected response functions have been obtained at three-momentum transfer values of 250 MeV/c and 500 MeV/c. The cross sections have been compared with two theoretical predictions: (1) that corresponding to a simple Fermi gas model; and (2) a more complex calculation [illegible] using shell model wave functions for the nuclei. It is not possible to obtain a unique momentum distribution from the data obtained in this experiment. The results are not completely described by the predictions of the Fermi gas model Momenta corresponding approximately to the Fermi momenta for calcium 40 and calcium 48 have been obtained. The shell model calculations are not in good enough agreement with the experimental data to permit any parameters of the model to be determined by this experiment. Dissert. Abstr.

N71-20433 Georgia Univ., Athens.

CONSTRUCTION OF A SET OF SELF-CONSISTENT EQUATIONS FOR CALCULATING THE STRONGLY INTERACTING PARTICLES

Gilmer Allen Gary (Ph.D. Thesis) 1969 204 p

Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 70-1155 CSCL 20H

After constructing a general procedure for successively continuing the invariant scattering amplitude into a region where the crossing relations gives a dynamical equation, a calculation of the self consistent iterative possibilities is carried out. The most general form of the modified Cheng representation is used for the partial

wave S-matrix which is checked out numerically for the rate of convergence against other Regge representations. A numerical bootstrapping calculation of the rho meson is carried out to show the possibilities of the equations derived. The width and mass obtained are 120 MeV and 762 MeV, respectively, in agreement with the experimental values of 90 to 150 MeV and 764 + or − 11 MeV. The set of equations derived appear to be feasible for the calculation of the strongly interacting particles, though a group of theoretical problems remain to be solved. Dissert. Abstr.

N71-20434# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

TOTAL PHOTOABSORPTION IN NUCLEI AND THE VALUE OF THE rho-NUCLEON CROSS SECTION

G. Mennessier and O. Nachtmann Dec. 1970 7 p refs

(LPTHE-70/48) Avail: NTIS

Using experimental information from rho meson photoproduction on hydrogen, instead of strict vector meson dominance, the total photoabsorption in nuclei insensitive to the rho meson - nucleon cross section is discussed. A SLAC experiment is found compatible with a much higher value for the cross section. Author

N71-20437 Rensselaer Polytechnic Inst., Troy, N.Y.

MICROWAVE STUDIES OF THIN SUPERCONDUCTING TIN FILMS

Donald Arvid Soderman (Ph.D. Thesis) 1969 193 p

Avail: Univ. Microfilms: HC $8.80/Microfilm $3.00 Order No. 70-2649

Microwave transmission measurements at 9.4 GHz were made through thin superconducting tin films as a function of temperature, perpendicular magnetic field, microwave power level, and dc bias current. The perpendicular magnetic field dependence of the microwave impedance is in better agreement with that calculated from a nonlocal spatial variation in the energy gap than that expected for fluxon flow phenomena. The Type 2 behavior of these superconducting films is confirmed by several low frequency flux penetration experiments. Transmission measurements made in the presence of a pulsed dc current and high power microwave fields allow a clear separation of regions where superelectron depairing and domain growth dominate. Low power transmission measurements in the presence of a perpendicular magnetic field suggest that domain growth is the result of fluxon penetration. Dissert. Abstr.

N71-20450# Joint Inst. for Nuclear Research, Dubna (USSR).

INTEGRAL EQUATIONS OF THE CASCADE KINEMATICS

V. G. Grishin, D. K. Kopylova, G. I. Kopylov, V. B. Lyubimov, and B. S. Yuldashev 1970 38 p refs In RUSSIAN

(JINR-P1-4926) Avail: AEC Depository Libraries

The case is considered when in the cascade decays, the effective masses of two groups of particles from different branches of cascades are measured. Two-dimensional distributions of these values are characterized by the internal structure: the lines of their level are determined by the cascade kinematics (laws of conservation) and not by the effective mass spectrum of the whole system of particles. The similar structure is possible also in the two-dimensional energy distribution. A notion of the kinematic potential-function of one variable, determining two-dimensional representations, is introduced. The integral equations are derived which allow one to determine the spectrum m sub eff of the whole system of particles without detection of all the final products. With the help of these equations the spectrum m(pion(+) pion(−) pion(0)) is reproduced over m(pion(+) pion(−) gamma) and m(pion(+) pion(−)) measurements. Author (NSA)

N71-20451# Atomic Weapons Research Establishment, Aldermaston (England).

MULTIGROUP NEUTRON DIFFUSION THEORY PERTURBATION PROGRAM SPECTRE

Pamela C. E. Hemment, E. D. Pendlebury, P. H. West, and W. H. G. Wilson Sep. 1970 39 p refs

(AWRE-O-74170) Avail: AEC Depository Libraries; HMSO 5s 6d; BIS$1.10

A description is given of the IBM 7030 (STRETCH) program SPECTRE in which Usachev's perturbation method is used to obtain the sensitivity of the neutron flux at the center of a system, as calculated by multigroup diffusion theory. SPECTRE uses, as part of its input, perturbation functions (on tape) calculated by a program SWAN-DP. The output from SPECTRE is on tape, which is used with the optimization program PENICUIK to calculate adjustments to cross sections to make them consistent with various types of integral measurements. Author (NSA)

N71-20452# Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaire.

RADIATION DAMAGE FROM IMPLANTED IONS

D. Dautreppe 1970 26 p refs Presented at Intern. Conf. on Hyperfine Interactions detected by Nucl. Radiation, Rehouot and Jerusalem, Israel, 6 − 11 Sep. 1970

(CEA-CONF-1645; CONF-700933-1) Avail: AEC Depository Libraries

The different methods of performing ion implantation (nuclear reactions or excitation and direct implantation with an isotope separator), and the damages involved during the process were studied under the following headings: the slowing down of the primary, the distribution of the implanted ion, general considerations about the damage from nuclear collision, lattice effects, annealing of the damage, energy and dose effects, and the final position of the implanted ion. Author (NSA)

N71-20454# Japan Atomic Energy Research Inst., Tokyo.

DEVELOPMENT OF IRRADIATION TECHNICS. 2: DOSIMETRY OF LARGE RADIATION SOURCES BY POLYMETHYLMETHACRYLATE

Ruichi Tanaka, Shoichi Mitomo, and Yunosuke Oshima Aug. 1970 21 p refs In JAPANESE; ENGLISH summary

(JAERI-Memo-4121) Avail: AEC Depository Libraries

Solid state dosimetry using radioinduced optical changes at the neighborhood of 290 millimicrons of commercial clear polymethylmethacrylate (PMMA) has been investigated for the purpose of development of a routine dosimetry system for high absorbed doses of both gamma rays and high energy electron beams. It is found that the optical density change is linear to absorbed dose between 0.1 and 2.5 Mrad, and that optical density change per unit dose for gamma rays is almost the same as for electron beams. The optical density increases for several hours after irradiation and then decreases slowly at any wavelength under 315 millimicrons, but it is nearly constant within 5 to 30 hours after irradiation. For the post-irradiation behavior, temperature effect and photosensitivity effect due to oxygen diffusion were observed, and the effect of polymerization initiator and residual monomer may be important. The advantages of the PMMA dosimeter are that the measurement method is simple, the size is small, and it is applicable to gamma rays, X rays, and electron beams. Author (NSA)

N71-20456*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A STUDY OF THE HARTREE-FOCK MODEL SPACE FOR LIGHT DEFORMED NUCLEI

William F. Ford, Richard C. Braley, and J. Bar-Touv (Negev Univ.) Washington Mar. 1971 47 p refs

(NASA-TN-D-6187; E-5941) Avail: NTIS CSCL 20H

A systematic investigation is made of the effects of altering the truncated basis space used in deformed Hartree − Fock studies of light nuclei. Both the number of basis functions and their radial dependence are varied; the latter is accomplished by changing the oscillator parameter or by using Wood − Saxon eigenfunctions.

From a study of properties both of the intrinsic Hartree - Fock state and the physical states projected from it, it is concluded that present results are too sensitive to alterations in the basis space to provide a meaningful test of the model. Author

N71-20457*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN INTEGRAL TEST OF INELASTIC SCATTERING CROSS SECTIONS USING MEASURED NEUTRON SPECTRA FROM THICK SHELLS OF Ta, W, Mo, AND Be

D. F. Shook, D. Fieno, C. H. Ford, and R. L. Alexander [1971] 9 p refs Presented at 3d Conf. on Neutron Cross Sec. and Technol., Knoxville, Tenn., 15 - 17 Mar. 1971; sponsored by Am. Nucl. Soc., Am. Phys. Soc., ORNL, AEC, and Univ. of Tenn.

(NASA-TM-X-52979; E-6193) Avail: NTIS CSCL 20H

Measured and calculated sphere leakage spectra in the energy range 0.5 to 11 MeV are used as a test of the accuracy of existing ENDF/B cross sections. Inelastic reactions are the primary cause of the large shift in the source spectrum as it traverses the spherical shell. A 50 Ci AmBe source was used as a source of fast neutrons at the center of 22 cm diameter spheres. The leakage spectra were measured at a distance of several hundred cm using an NE213 liquid scintillator neutron spectrometer. Room scattered neutron backgrounds were accounted for using a shadow cone. The spectra were calculated with 51 groups using ENDF/B and other cross sections and an Sn discrete ordinate transport code. The sensitivity of the leakage spectra to small changes in the cross sections was calculated. A comparison between the calculated and measured spectra for Mo shows general agreement but significant discrepancies are observed for W, Ta, and Be. Author

N71-20488*# Stanford Research Inst., Menlo Park, Calif. Molecular Physics Group.

THEORETICAL RESEARCH: ELECTRONIC, IONIC, AND ATOMIC IMPACT PHENOMENA Final Report

Felix T. Smith 31 Jan. 1971 22 p refs

(Contract NASr-49(07); SRI Proj. PYU 4070)

(NASA-CR-117178; SU-32) Avail: NTIS CSCL 20I

The results are presented of a program aimed at developing, for some wide classes of collision problems, sufficient knowledge to generate simple and rapid methods for estimating cross sections and reaction rates needed for practical applications. The methods developed are applicable to several classes of reactions including: ion-ion neutralization, charge transfer at large distances, and optical or metastable excitation connected with charge transfer. The more general and formal aspects of collision theory are broadly considered along with specific applications of collision theory to specific scattering processes observed in the laboratory. Particular emphasis is placed on the analysis and interpretation of experimental results in the light of theoretical principles. D.L.G.

N71-20514# Illinois Univ., Urbana. Dept. of Physics.

CLUSTER DECOMPOSITION PROPERTIES OF phi CUBED PERTURBATION THEORY AMPLITUDES AT HIGH ENERGY

David K. Campbell and Shau-Jin Chang Feb. 1971 81 p refs

(Grant NSF GP-25303)

(ILL-(TH)-71-5) Avail: Issuing Activity

A cluster decomposition technique similar to that used in statistical mechanics, applicable to studying high energy processes is presented. The multiperipheral amplitudes in a phi cubed filed theory with one space and one time dimension are examined in detail. The application of the technique to a phi cubed theory with three space and one time dimension is considered. A simple criterion is established, based on the form of the cluster decomposition, to determine whether a set of amplitudes leads to a Regge pole or to a more complicated singularity structure. Author

N71-20518* Hughes Aircraft Co., Los Angeles, Calif.

SYSTEM FOR MONITORING THE PRESENCE OF NEUTRALS IN A STREAM OF IONS Patent

Kenneth R. Pinckney and Brian Del Curto, inventors (to NASA) Issued 25 Feb. 1969 (Filed 1 Sep. 1965) 5 p Cl. 324-33; Int. Cl. G01n27/62 Sponsored by NASA

(NASA-Case-XNP-02592; US-Patent-3,430,131; US-Patent-Appl-SN-484490) Avail: US Patent Office CSCL 20H

To facilitate more accurate ion engine control, a neutral detector was constructed to produce working signal currents that are many magnitudes greater than available signal currents. A hollow cylindrical collector is utilized that is made of a material providing high secondary electron emission. It contains an entrance aperture in its surface, and carries a heated filament generally along its longitudinal axis. The collector is biased negative relative to the filament. An atom enters through the aperture, strikes the filament and is ionized. The ion is then repelled by the positive bias on the filament and impinges on the collector, knocking off electrons. It then becomes a neutral. The collector is heated so as to boil off the neutrals, which drift until they once again hit the filament to repeat the process.

Official Gazette of the U.S. Patent Office

N71-20528# Commissariat a l'Energie Atomique Saclay (France). Centre d'Etudes Nucleaires.

MEASUREMENT AND ANALYSIS OF THE DIFFERENTIAL CROSS SECTIONS FOR THE REACTION OF PION(-) PROTON YIELDS ETA-MESON NEUTRON AT SIX ENERGIES BETWEEN 2.9 AND 18.2 GeV/c [MESURE ET ANALYSE DES SECTIONS EFFICACES DIFFERENTIELLES DE PRODUCTION DU MESON ETA DANS LA REACTION PION(-) PROTON YIELDS ETA-MESON NEUTRON A 2.9 ET 18.2 GEV/C]

Pierre A. Borgeaud (Ph.D. Thesis) 1970 110 p refs In FRENCH

(CEA-R-4037) Avail: AEC Depository Libraries

A heavy plate spark chamber was used to detect the two gamma radiations of the neutral decay model of the eta-meson produced in the reaction negative pion proton yields eta-meson neutron. The events were shown to be free of any contamination due to inelastic reactions. The differential cross sections showed a prominent forward peak. The results obtained were discussed in the framework of a single pole Regge model. Information on the A sub 2 trajectory was obtained and compared to that available by other methods, namely sum rules. NSA

N71-20535*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

AVERAGE ENERGIES OF GROUND AND SINGLY AND DOUBLY EXCITED CONFIGURATIONS IN HIGHLY IONIZED ATOMS: ELECTRON NUMBERS N = 3 TO N = 20

Yehuda Shadmi and Sidney O. Kastner Washington 1971 258 p refs

(NASA-SP-3056) Avail: NTIS CSCL 20H

Calculations are presented of the average energies for many configurations of spectroscopic interest, using a basis of orthogonalized screened hydrogenic radial functions. The energy of a core is calculated in a zeroth-order approximation (electronic interactions included implicitly through the screening parameters) and the energy of all other electrons is calculated in a first-order approximation (electronic interactions included explicitly as a perturbation). Results are presented for the ground configurations and for many singly and doubly excited configurations. A discussion of their accuracy is included. Author

N71-20552# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

RENORMALIZATION IN THE DUAL RESONANCE MODEL.

ITS ARBITRARINESS IN THE GENERAL CASE AND FOR UNIT INTERCEPT
J. Scherk Dec. 1970 30 p refs
(LPTHE-70/45) Avail: NTIS

It is shown in the case of arbitrary intercept that the finite part of the planar one-loop diagram can be defined by imposing duality. Regge behavior with linear trajectories and unitarity, up to a class of functions of the external momenta depending on an infinite number of arbitrary parameters. In the Virasoro case of unit intercept, it turns out that the infinite parts of the planar and nonorientable one-loop diagrams factorize into a finite momentum dependent part and two infinite constants. Always in that case it is argued that the renormalization of all planar graphs depends on a single constant. Author

N71-20555# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
PROCEEDINGS OF THE SECOND INTERNATIONAL COLLOQUIUM ON PEPR
Terence L. Watts, ed. May 1970 414 p refs Conf. held at Cambridge Mass., 5 – 7 May 1970
(Contract AT(30-1)-2098)
(MIT-2098-660; CONF-700519) Avail: NTIS HC $6.00/MF $0.95

Conference papers are presented on the status of PEPR devices, bubble chamber physics problems, CRT devices for processing film, and related instrumentation. N.E.N.

N71-20558# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
A SINGLE PARTICLE STATE OF DEFORMED NUCLEI IN TRANSURANIUM REGION OF SAXON-WOODS POTENTIAL
F. A. Gareev and S. P. Ivanova 1970 23 p refs In RUSSIAN
(JINR-P4-5221) Avail: AEC Depository Libraries

Use of the anisotropic oscillator potential as the mean nuclear field is not fully satisfactory, although for some rare earths the results agree with experimental data. In the transuranium region, the scheme presents additional difficulties. An earlier approximation method for solving Schrodinger's equation by means of the Saxon-Woods potential for spherical and deformed nuclei has been successfully applied to describe the properties of nuclei in the rare earth region. The method is precise and retains the advantages of Nilsson's approximation while overcoming its shortcomings. This one particle level scheme is presented for nuclei in the transuranium region by calculating the levels of the A = 239 nucleus. The order of filing of the ground states was not sufficiently well indicated by the scheme; however, introduction of a hexagonal deformation resulted in a satisfactory one particle scheme for odd transuranium nuclei. NSA

N71-20559# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
IRRADIATION DAMAGE FROM PILE NEUTRONS [DOMMAGES D'IRRADIATION EN NEUTRONS DE PILE]
M. Chance and J. P. Genthon 9 Mar. 1970 7 p refs In FRENCH Presented at the Working Group of the AIEA on the Meas. of Reactor Radiations, Grenoble, France, 18 – 20 Mar. 1970
(CEA-CONF-1523; CONF-700326-1) Avail: AEC Depository Libraries

The irradiation damage to graphite and steel from reactor neutrons is considered. The definition and measurement of the number of displaced atoms in graphite are discussed. The theoretical and experimental study planned for the determination of the effect of the duration of irradiation is outlined. The effects of reactor neutrons on the mechanical properties and swelling of steel are described. NSA

N71-20560# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
SLOW BEAM DEFLECTION FOR DESY [DIE LANGSAME STRAHLAUSLENKUNG BEI DESY]
G. Hemmie and H. Walther Oct. 1970 55 p refs In GERMAN; ENGLISH summary
(DESY-70/51) Avail: AEC Depository Libraries

Reasons for the failure of slow third-order resonant beam extraction using a current sheet at DESY are investigated. The theory of resonant beam ejection is briefly presented. Theoretical results are discussed in comparison to practical experience with the current sheet ejection. Finally, approximative results of calculations for an ejection with separated functions (sextupol, quadrupol, septum) are given. Author (NSA)

N71-20561# Kernforschungszentrum, Karlsruhe (West Germany).
METHOD OF CHANGING THE FIELD GRADIENTS IN ISOCHRONOUS RING CYCLOTRONS [EIN VERFAHREN ZUR AENDERUNG DES FELDANSTIEGES IN ISOCHRONEN RINGZYKLOTRONS]
G. Schatz Sep. 1970 25 p refs In GERMAN; ENGLISH summary
(KFK-1268) Avail: AEC Depository Libraries

A method of adjusting isochronism in separated sector isochronouc cyclotrons is investigated. By use of differently shaped magnets with different radial field increase, it is possible to obtain an exactly isochronous field at two final energies without use of trimming coils. The remaining deviation from isochronism is less than a few parts in a thousand over a wide range of final energies. As an example, a 250 MeV variable energy proton accelerator is discussed. It is shown that the different types of magnets differ considerably in size and that the influence of the small magnets on the focusing properties is small. Author (NSA)

N71-20562# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
UPPER BOUNDS ON THE NEUTRAL CURRENT WITH DELTA S = 1
Takemi Hayashi, Michiji Konuma, Nasami Nakagawa, and Hidemitsu Nitto Jan. 1971 7 p refs
(RIFP-113) Avail: NTIS

Since the discovery of CP violation followed by the accumulation of experimental data on rare weak processes, it has become important to see if the neutral current be allowed in the semileptonic interaction up to a level of strength of the CP violation. It is shown that the present experimental data do not exclude the possible existence of the neutral current with Delta S = 1 of a milli-weak level in the coupling strength. Author

N71-20572# Columbia Univ., New York. Dept. of Physics.
QUANTUM THEORY OF (H,H2) SCATTERING: APPROXIMATE TREATMENTS OF REACTIVE SCATTERING
K. T. Tang and M. Karplus [1970] 51 p refs Sponsored by AEC Prepared in cooperation with Harvard Univ.
(HUX-3780-30) Avail: NTIS

The problem is formulated in terms of a form of the distorted-wave Born approximation (DWBA) suitable for collisions in which all particles have finite mass. Two limiting models are compared; in one, the molecule is unperturbed by the incoming atom and in the other, the molecule adiabatically follows the incoming atom. The adiabatic model seems to be more appropriate. Since the DWBA method is complicated, a much simpler linear model is developed. The present model includes the full three-dimensional aspect of the collision and it is only the evaluation of the transition matrix element itself that is simplified. It is found that the linear model gives results in good agreement with that of the DWBA method. By application of this model, the energy

dependence, rotational state of dependence, and other properties of the total and differential reaction cross sections are determined. The most important result is that the differential cross sections are strongly backward peaked at low energies and shifts in the forward direction as the energy increases. Author

N71-20573# Ceskoslovenska Akademie Ved, Prague.
S-MATRIX CALCULATIONS OF THE PION-NUCLEON P-WAVE SCATTERING LENGTH a 13 BY THE N/D METHOD
V. F. Sachl (Fysikalni Univ. and Durham Univ.) 1970 17 p refs
(NP-18553) Avail: AEC Depository Libraries

According to the Balazs method the numerator function is considered in a three pole approximation with two unknown residues and one known, which is chosen in the nucleon pole. In calculations for that purpose the contributions of discontinuities of the rho-meson, the pion-meson-nucleon/3,3/isobar N* and the high-energy contributions in the crossed channels and the nucleon pole in the direct channel are taken as the input values. The matching procedure is the usual one. The fully determining equations are achieved in the matching point through the comparison of the projections of invariant amplitudes and their first and higher derivatives with the N/D representation and its first and higher derivatives on the other side, respectively. The value of the determined pion-meson-nucleon scattering length a13 = −0.019 is in excellent agreement with the experimental value. Author (NSA)

N71-20574# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
PHENOMENOLOGICAL INVESTIGATION OF INELASTIC ELECTRON-PROTON SCATTERING
O. Nachtmann Dec. 1970 15 p refs
(LPTHE-70/49) Avail: NTIS

Contour lines for the structure function nu W2 are drawn. Scaling behavior is clearly exhibited for omega < 8. For larger omega a diffractive mechanism seems to dominate. Combining data from inelastic e-p scattering with those from photoproduction and complex nuclei, the region of validity of the vector dominance model is studied. A qualitative change seems to take place at Q sq approximately = 0. Author

N71-20577# Oak Ridge National Lab., Tenn.
NUCLEAR FUSION RESONANCE REACTIONS OF POSSIBLE CTR INTEREST
J. Rand McNally, Jr. Jan. 1971 6 p refs Revised
(Contract W-7405-eng-26)
(ORNL-TM-3233-Rev) Avail: NTIS

Some speculations are presented on possible nuclear fusion resonance reactions that may be of importance in the development of clean controlled thermonuclear reactors of either toroidal or mirror type. Author (NSA)

N71-20578 Yale Univ., New Haven, Conn.
PROPERTIES AND APPLICATIONS OF SINGLE PARTICLE EIGENFUNCTIONS IN A DEFORMED NUCLEAR POTENTIAL WELL
David Webster Watkins (Ph.D. Thesis) 1969 370 p
Avail: Univ. Microfilms: HC $16.65/Microfilm $4.75 Order No. 70-2827

Calculation of low-lying nuclear energy levels for the odd-A nuclei Yb-177, Re-183, Er-167, and Pu-239 is considered. A Hamiltonian to calculate single particles in a spheroidal Woods-Saxon potential with energy- and isospin-dependent well depth, strong spin-orbit coupling and, for protons, the Coulomb potential of a charged spheroid is presented. The Hamiltonian is diagonalized using matrix algebra. A technique is developed for imposing quadrupole and hexadecapole perturbations on the spheroidal levels. Shell corrections using the method of Strutinskii and pairing corrections from BCS theory are discussed. Equilibrium nuclear deformations for the various nuclear excitations are found by minimizing the corresponding BCS energies. It is found that the equilibrium shapes of the nuclei studied contain amounts of hexadecapole distortion different from that prescribed by the pure spheroidal shape. Computer codes with sample programs are given. Dissert. Abstr.

N71-20584# Brandeis Univ., Waltham, Mass. Dept. of Physics.
HYPERFINE FIELD OF Sc IN A Ni HOST
H. C. Benski and C. Hohenemser [1970] 5 p refs Presented at the Intern. Conf. on Hyperfine Interactions detected by Nucl. Radiation, Rehovot−Jerusalem, 6−11 Sep. 1970 Submitted for publication Supported by AEC
(CONF-700933-4) Avail: NTIS

The hyperfine field of Sc-44 in a Ni host was measured from 80 K to the Curie point, using time differential perturbed angular correlations. The extrapolated field at 0 K is −25.9 + or − .3 kG. A previously reported Curie point shift was removed. Author

N71-20585# Brandeis Univ., Waltham, Mass. Dept. of Physics.
PERTURBED ANGULAR CORRELATION EXPERIMENTS ON Rh-100 IN A Ni HOST NEAR THE CURIE POINT
R. C. Reno and C. Hohenemser [1970] 5 p refs Presented at the Conf. on Hyperfine Interactions Detected by Nucl. Raidiation, Rehovot and Jerusalem, Israel, 6−11 Sep. 1970
(CONF-700933-3) Avail: NTIS

A single valued critical exponent of beta = 0.385 + or − .005 was obtained from hyperfine field measurements on Rh-100 in a Ni host. It is concluded that the value of beta for the range 0.0001 < (1 − T/Tc) < 0.1 is in agreement with very precise bulk measurements, but is at variance with reported results that for (1 − T/Tc) < 0.01 beta becomes 1/2. Author

N71-20586# Reactor Centrum Nederland, Petten.
MEASUREMENTS AND CALCULATIONS ON THERMAL ARGONAUT TYPE, CORES IN THE STEK-FACILITY AT PETTEN
J. Coehoorn, H. Th. Klippel, F. M. de Meulemeester, J. Smit, J. W. N. Tuyn et al Feb. 1970 69 p refs
(RCN-118) Avail: AEC Depository Libraries

A coupled fast-thermal system, STEK, was initiated for measuring integral cross sections of actual fission product-mixtures, -elements, and -nuclides. The possibility to build up the thermal Argonaut type cores in STEK was included in the design. Thus the inner zone of the core was completely filled with graphite elements and then fuel plates were loaded in steps as symmetrically as possible in the 4 × 10 elements in 4 slabs. A series of standard experiments were performed including calibration of the controls control plates and stop rods, measurement of the thermal neutron flux distribution and the reactor power, kinetic experiments to determine the neutron lifetime and coupling between the separate slabs, and finally oscillator experiments to test the oscillator system and inverse kinetic program with the on-line computer. The results of all these measurements are presented and are in some cases compared with calculations. Author (NSA)

N71-20587# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
NUCLEAR PHYSICS DEPARTMENT. Annual Progress Report, Oct. 1968 Sep. 1969. [DEPARTEMENT DE PHYSIQUE NUCLEAIRE. COMPTE RENDU D'ACTIVITE, 1 OCTOBRE 1968 30 SEPTEMBRE 1969]
30 Sep. 1969 229 p refs In FRENCH
(CEA-N-1232) Avail: AEC Depository Libraries

Operational and experimental techniques associated with the electron linear accelerator are reported and nuclear experiments carried out with the cyclotrons and the Van de Graaff machine are outlined. Studies include: (1) inelastic and elastic proton scattering with interpretation of scattering processes and descriptions of scattering instrumentation technologies; and (2) ion source exchange reactions with spectroscopic measurements of resonances in excited states of metals and experimental induction of transfer reactions. G.G.

N71-20592# Oak Ridge National Lab., Tenn.
PHYSICS DIVISION Annual Progress Report Ending 31 Dec. 1969
Felix E. Obenshain Jun. 1970 155 p
(Contract W-7405-eng-26)
(ORNL-4513) Avail: NTIS

Continuing research is reported in the following areas: general, Brueckner Hartree Fock, and shell model theories; high energy physics, nuclear structure and energy levels; nuclear reactions and radioactivity; Mossbauer spectroscopy; atomic and molecular physics; and equipment for physics research. N.E.N.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N71-19685 Syracuse Univ., N.Y.
RADIATION AND SCATTERING OF ELECTROMAGNETIC WAVES FROM A CYLINDRICAL INHOMOGENEOUS PLASMA STRUCTURE
William C. Wong (Ph.D. Thesis) 1969 143 p
Avail: Univ. Microfilms: HC $6.80/Microfilm $3.00 Order No. 70-1984

The scattering and radiation of electromagnetic waves from a radially inhomogeneous cylindrical plasma structure is discussed. Scattering problems investigated consist of medium-frequency scattering at an oblique angle of incidence, and high-frequency scattering at normal incidence. Radiation problems include two-dimensional radiation from an axially slotted cylinder, three-dimensional radiation from an arbitrary aperture on a conducting cylinder, and three-dimensional radiation from a magnetic dipole. In the former two cases, the clyinder is coated with an inhomogeneous and anisotropic plasma sheath, and in the last case, the magnetic dipole is immersed in a radially inhomogeneous, isotropic plasma column. Closed-form solutions are obtained where possible. In cases where the governing equations do not yield closed-form solutions, stratification technique is used in conjunction with a newly introduced transmission coefficient matrix to obtain analytical solutions. Dissert. Abstr.

N71-19686# California Univ., Livermore. Lawrence Radiation Lab.
CONDITIONS FOR LANDAU DAMPING AND WAVE REFLECTIONS IN OPEN-ENDED MAGNETIC WELL PLASMAS
Gordon W. Hamilton and Ralph W. Moir 3 Jun. 1970 15 p refs
(URCL-50900) Avail: NTIS

Conditions are examined for Landau damping and wave reflections of convective electron plasma waves in open-ended magnetic-well plasmas. Velocity-matching (v sub e = v sub wave) is a necessary but not a sufficient condition for stability due to Landau damping. One finds that the necessary conditions required for damping by velocity-matching are always satisfied towards the end of the plasma where the density is dropping off, provided the wave can propagate to that point before reflection occurs. However, Baseball I data shows that velocity matching is not a sufficient condition for stability. Necessary conditions can be satisfied for a sufficiently strong magnetic field or for a sufficiently smooth (collisional) density profile; however, further analysis is required to determine the sufficient conditions for stability. Author (NSA)

N71-19704# Princeton Univ., N.J. Plasma Physics Lab.
SKIN-EFFECT IN POWERFUL Z-DISCHARGES
L. V. Dubovoi et al Oct. 1970 26 p refs Transl. into ENGLISH from Russian preprint No. T-0107
(Contract AT(30-1)-1238)
(MATT-Trans-102) Avail: NTIS

Experiments with pulsed z discharges characterized by anomalous plasma conductivity in the skin layer region are discussed. It is demonstrated that the characteristic features of behavior of powerful direct discharges, in particular, fast z-pinches, agree with the hypotehsis of probable excitation of ion-acoustic microinstability in the current layer of the discharges. Author (NSA)

N71-19705# Drexel Univ., Philadelphia, Pa.
STUDIES IN ELECTROMAGNETIC SCATTERING FROM TURBULENT WAKES Final Report
John Jarem Oct. 1970 274 p refs
(Contract DAHC04-67-C-0072; ARPA Order 1009)
(AD-716587; AROD-7471-5-E) Avail: NTIS CSCL 20/9

Contents: Scalar scattering from turbulent plasmas by a modified method of iteration; Vector scattering from a turbulent plasma by a modified method of iteration; Application of the modified method of iteration for scattering to SRI experiment; Wave scattering from a unidimensional layer with strong random irregularities by the method of smoothing; Scattering coefficients of one-dimensional plasmas of Epstein-type profiles with small random irregularities. GRA

N71-19805*# National Aeronautics and Space Administration, Washington, D.C.
FIFTH NASA INTERCENTER AND CONTRACTOR CONFERENCE ON PLASMA PHYSICS. PART 1: PROGRAM AND INTRODUCTION
1966 29 p refs Conf. held at Washington, 24 - 26 May 1966
(NASA-TM-X-66953) Avail: NTIS CSCL 20I

A discussion is presented on the role of plasma research in future space technology. It is pointed out that the economics of commercial use of space depend heavily on advanced space systems, particularly in regard to high energy density propulsion. Various considerations are presented that lead to the conclusion that research in plasma physics is the crucial stepping stone in the development of space systems with increasing compactness and higher efficiency. D.L.G.

N71-19806*# National Aeronautics and Space Administration, Washington, D.C.
FIFTH NASA INTERCENTER AND CONTRACTORS CONFERENCE. PART 5: PLASMA PHYSICS RESEARCH UNDER RRP, RRE, RNT, AND SG PROGRAMS
1966 132 p refs Conf. held at Washington, 24 - 26 May 1966
(NASA-TM-X-66952) Avail: NTIS CSCL 20I

Abstracts of papers presented at a conference on plasma physics are given. Topics covered include: synthesis and characterization of magneto-fluids; anode oscillations in cesium plasmas; pulsed plasma propulsion, pulsed plasma accelerator; plasma turbulence; plasma resonance phenomena; modes of collisionless plasma; and interaction of energetic electron and a plasma. Other subjects reported on include: plasma boundaries; beat frequency interferometer

for plasma diagnostics; plasma radiation and detection of non-Maxwellian velocity distributions; harmonic generation in a microwave plasma; and critical mass flow model for the MPD arc jet. E.M.C.

N71-19807*# National Aeronautics and Space Administration. Washington, D.C.
FOURTH NASA INTERCENTER CONFERENCE ON PLASMA PHYSICS
1963 155 p refs Conf. held at Washington, 2–4 Dec. 1963
(NASA-TM-X-66951) Avail: NTIS CSCL 20I

Summaries of papers presented at a plasma physics conference are given which include the following topics: plasma theory and plasma generation; dynamics of pulsed plasmas; dc-plasma acceleration and heating; ac-plasma acceleration and Hall-current accelerators; plasma-wave interactions; magnetohydrodynamics; plasma energy conversion; and plasma diagnostics. J.M.

N71-19808*# National Aeronautics and Space Administration. Washington, D.C.
FIFTH NASA INTERCENTER AND CONTRACTORS CONFERENCE ON PLASMA PHYSICS. PART 4: PLASMA PHYSICS RESEARCH AT NASA AMES RESEARCH CENTER AND AT JET PROPULSION LABORATORY
1966 109 p refs Conf. held at Washington, 24–26 May 1966
(NASA-TM-X66991) Avail: NTIS CSCL 20I

Abstracts of papers presented at a plasma physics conference are given. Topics covered include: ablation products radiation; effects of turbulence in constricted-arc plasma generators; behavior of Faraday cups in plasma beams; flow swallowing enthalpy probes; constricted arc performance status; and ionic recombination rate of dissociated nitrogen. Other subjects reported on included: comparison of experimental with predicted convective heat transfer from laminar boundary layer of thermally ionized argon; behavior of a magnetic neutral line in a plasma; laser induced breakdown, electron recombination and shock wave structure in a partial ionized gas; high purity shock tube ionization studies; magneto-fluid dynamic flow over bluff bodies; and research in plasmas in thermionic diodes. J.M.

N71-19809*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SIXTH NASA INTERCENTER AND CONTRACTORS CONFERENCE ON PLASMA PHYSICS. PROGRAM AND ABSTRACTS
1969 229 p refs Conf. held at Langley Station, Va.
(NASA-TM-X-66950) Avail: NTIS CSCL 20I

Abstracts presented include the following areas of plasma physics research: (1) plasma acceleration; (2) power generation; (3) plasma sheaths and boundary layers; (4) oscillations and instabilities; (5) turbulence; (6) geomagnetospheric plasmas; (7) ion and molecular gas lasers; (8) plasma focus, theta pinch, and laser produced plasmas; (9) fundamental plasma problems; (10) arc heaters; and (11) entry plasmas. D.L.G.

N71-19810*# National Aeronautics and Space Administration, Washington, D.C.
FIFTH NASA INTERCENTER AND CONTRACTORS CONFERENCE ON PLASMA PHYSICS. PART 3: PLASMA PHYSICS RESEARCH AT NASA LEWIS RESEARCH CENTER
1966 59 p refs Conf. held at Washington, 24–26, 1966
(NASA-TM-X-66910) Avail: NTIS CSCL 20I

Abstracts of research are presented and include the following studies: (1) generating a hot-ion, magnetically confined plasma with a modified Penning discharge; (2) harmonic response of forced non-linear plasma waves; (3) RF power transfer to ion cyclotron waves; (4) electron impact cross section for atomic and molecular hydrogen calculated by Gryzinski's classical theory; (5) preliminary measurement of plasma fluctuation in a Hall current accelerator; (6) effect of magnetic beach on RF power absorption in ion cyclotron resonance; (7) the possibility of anomolous cathode emission due to ion induced tunneling; (8) consideration of irreversible thermodynamics as an approach to a MHD plasma problem; (9) performance, endurance, and diagnostics of magnetic expansion thrustor; (10) a Langmuir calorimetric probe to determine average energy in a plasma beam; (11) volume ion production cost in tenuous plasmas; (12) charged particle transport by Monte Carlo analysis; and (13) electron distribution function and number density in nonequilibrium MHD plasma. D.L.G.

N71-19811*# National Aeronautics and Space Administration.
FIFTH NASA INTERCENTER AND CONTRACTORS CONFERENCE ON PLASMA PHYSICS. PART 2: PLASMA PHYSICS RESEARCH AT NASA LANGLEY RESEARCH CENTER
1966 156 p refs Conf. held at Washington, 24–26 May 1966
(NASA-TM-X-66909) Avail: NTIS CSCL 20I

Abstracts of papers presented at a plasma physics conference are given. Topics covered include: linear crossed-field plasma accelerators and electric forces on satellites; plasma spectroscopy and plasma guns; experiment and theory of the MPD arc; diagnostics for high-power, low-density, steady plasma streams; collisionless plasmas; reentry flight plasmas; and a barium release experiment. E.M.C.

N71-19980# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
NUMERICAL STUDY OF DRIFT INSTABILITIES IN A COLLISIONLESS PLASMA
Ph. Brossier Oct. 1970 41 p refs In FRENCH
(EUR-CEA-FC-565) Avail: AEC Depository Libraries

The dispersion relation of drift instabilities in an inhomogeneous plasma is solved for complex values of the frequency. This computation gives the curves with constant growth rate in the wavelength plane. The influence of the following parameters: density, electron to ion temperature ratio, mass ratio, and existence of a temperature gradient, is studied. Author (NSA)

N71-19983# United Kingdom Atomic Energy Authority, Culham (England).
ON LINE DATA ACQUISITION SYSTEM USING A LINC-8 COMPUTER
E. G. Murphy and C. A. Steed May 1970 33 p refs
(CLM-R-104) Avail: AEC Depository Libraries

The hardware and software of an on-line data acquisition system used on a plasma physics experiment are described. The purpose of the system is to sample analog signals under program control, file the data on magnetic tape, perform routine computations on that data, print out the results, and display the raw data in an easily assimilable form on an oscilloscope. The programs are designed to provide a flexible system and, by making programs fully interactive where necessary, to be used by people with no knowledge of computers. Author (NSA)

N71-19984*# Princeton Univ., N.J. Guggenheim Aerospace Propulsion Labs.
THE CATHODE REGION OF A QUASI-STEADY MAGNETOPLASMADYNAMIC ARCJET, SUPPLEMENT 8
Peter J. Turchi and R. G. Jahn Oct. 1970 151 p refs
(Grant NGL-31-001-005)
(NASA-CR-117040; Rept-940-Suppl-8) Avail: NTIS CSCL 20I

A magnetoplasmadynamic discharge is examined near the cathode of a 2.5 MW, quasi-steady, self field arcjet. High speed photography shows a concentration of arc luminosity in the

cathode region, while detailed measurements with electric and magnetic field probes indicate that 85% of the total arc power is deposited within one base diameter of the cathode surface. Ion energies are shown to be proportional to the voltage drop in the cathode region even though current conduction is accomplished primarily by electrons in a tensor manner. It is found that a high speed plasma flow is delivered to the cathode where it is converted into a useful exhaust jet in a thin, high density layer at the cathode surface. Local measurements of electron temperature and estimates of electron density, made within the discharge and exhaust jet using a twin Langmuir probe technique, indicate a nearly uniform electron temperature of about 1.5 eV throughout the quasi-steady arcjet flow. Author

N71-20013# P. E. C. Research Associates, Inc., Louisville, Colo.
INVESTIGATION OF THE DYNAMICS OF IONIZED MEDIA (PLASMAS) Final Technical Report
W. Brittin, W. Chappell, and W. Wyss Wright-Patterson AFB, Ohio ARL Sep. 1970 145 p refs
(Contract F33615-69-C-1555)
(AD-715997; ARL-70-0153) Avail: NTIS CSCL 20/9

Functional methods are applied to the statistical mechanics of radiation interacting with charged particles. An extensive treatment of quantum mechanical representations in phase space has been carried out. The concept of coherent states applied to many-body problems appears to be new and offers interesting possibilities for the description of macroscopic systems governed by quantum mechanical laws. One also presents work on kinetic equations involving particles, atoms, and radiation. In particular one has treated such problems as line-broadening and correlations in a plasma. From a more mathematical point of view one has investigated the algebraic structure of phase space and presents some preliminary results. Author (GRA)

N71-20014# Berkeley Analytical Sciences Service, Inc., Calif.
PROPERTIES OF SLOWING DOWN REACTIONS Final Scientific Report, 1 Jun. 1969 – 1 Jun. 1970
John L. Wyatt, Wayne B. Day, C. K. Hinrichs, and M. M. Reynolds 30 Jun. 1970 46 p refs
(Contract F44620-69-C-0111)
(AD-716594; AFOSR-70-2101-TR) Avail: NTIS CSCL 20/9

The basic purpose of this research program is to evaluate the role of direct nuclear reactions in thermonuclear plasma systems. Such reactions as elastic nuclear scattering can significantly alter the power balances and energy exchange rates calculated for hot electron plasmas accounting for coulomb interactions only. Author (GRA)

N71-20015# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
SPECTROSCOPIC PLASMA DIAGNOSTICS FOR ADVANCED AEROSPACE VEHICLES Interim Scientific Report, 1968 – 1970
R. M. Measures 3 Nov. 1970 71 p refs
(Grant AF-AFOSR-1608-68)
(AD-716002; AFOSR-70-2607TR) Avail: NTIS CSCL 20/9

A great deal of research in recent years has been directed to developing ways of generating an inverted population in order to produce lasing action. The current research programme has been concerned with using laser radiation to redistribute the atomic level population of some species in order to probe the conditions within a gas or plasma. When an atomic transition is optically pumped by an appropriately tuned beam of laser radiation the population in the upper state of the transition can be considerably enhanced along the path of the beam. This will give rise to an intensification of the spontaneous emission emanating from the overpopulated state. It is from a study of this intensified emission that information can be ascertained pertaining to the condition of the specific volume element being pumped. The authors refer to this technique as Selective Excitation Spectroscopy. Author (GRA)

N71-20016# Naval Research Lab., Washington, D.C.
THE SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS USING A SYMBOLIC STYLE OF ALGOL Final Report
Jay P. Boris Nov. 1970 34 p refs Sponsored in part by DASA and AEC
(AD-716404; NRL-MR-2168) Avail: NTIS CSCL 20/9

The paper presents a symbolic style of programming the ALGOL language which is particularly well suited for application to the solution of partial differential equations in magnetohydrodynamics. The techniques described have been applied to problems of interest in the Plasma Dynamics Branch and an example thereof is given. Author (GRA)

N71-20099# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
CIRCULARIZED QUADRUPOLAR MAGNETIC WELL: DECA 2B
P. Lecoustey and J. Tachon 1970 8 p refs Presented at 6th Symp. on Fusion Technol., Aachen, 22 – 26 Sep. 1970 Sponsored by Euratom
(CEA-CONF-1665; CONF-700928-5) Avail: AEC Depository Libraries

A new way to reduce the plasma wall interaction in a magnetic well is proposed. It involves the focusing of the magnetic field lines on the outside of the mirror region by two additional quadrupolar windings. The application of this concept to the rebuilding of DECA II B experiment is described. Author (NSA)

N71-20100*# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
SUPERCONDUCTING QUADRUPOLAR COIL FOR A NEUTRAL ATOM MULTI-INJECTION EXPERIMENT
P. Asesio, A. Berruyer, G. Bronca, J. Krikorian, R. Dei-Cas et al 1970 7 p refs Presented at the 6th Symp. on Fusion Technol., Aachen, 22 – 26 Sep. 1970 Sponsored by Euratom
(CEA-CONF-1663; CONF-700928-1) Avail: AEC Depository Libraries

In order to suppress the anisotropy and loss-cone drift instabilities that can develop in minimum-B devices, a plasma produced in a magnetic well by ten neutral beams injected at different angles was proposed. Due to the long duration and high value of the magnetic field necessary for such a plasma, a superconducting quadrupolar coil was suggested. The coil shape was chosen for easy access to the beams and associated equipment. To reduce the wall desorption under fast-particle impact, the liner must be baked at 400 C and, in operation, should be near room temperature. The main technological problems connected with this project are discussed: the maximum magnetic field and mechanical stress on the conductors, cryogenic aspects, and vacuum during the beam injection. Author (NSA)

N71-20117# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.
THEORETICAL AND EXPERIMENTAL STUDY OF A NON-LINEAR DISINTEGRATION PROCESS FOR A LANGMUIR WAVE [ETUDE THEORIQUE ET EXPERIMENTALE D'UN PROCESSUS NON LINEAIRE DE DESINTEGRATION D'UNE ONDE DE LANGMUIR]
Mariano Perulli (Ph.D. Thesis – Paris Univ.) 1969 200 p refs In FRENCH
(CEA-R-3639) Avail: AEC Depository Libraries

The Vlasov equation was used to calculate nonlinear coupling between three electronic plasma waves (Langmuir waves) which propagate in a cylindrical plasma column confined by a strong magnetic field. The disintegration of a Langmuir wave excited in the plasma column by means of an antenna was studied. Space structure measurements for various waves show that the resonance conditions (selection rules) are satisfied. The measured disintegration

threshold is in agreement with the theoretical value within 30%. The variation of the spatial growth rate as a function of the amplitude of the disintegrated wave shows that the resulting waves are correlated in groups of three along the magnetic field even though the disintegrating spectrum appears in a wide frequency band. Author (NSA)

N71-20213# Academy of Sciences (USSR), Moscow. Space Research Inst.

APPARATUS FOR LABORATORY SIMULATION OF IONOSPHERIC FLOW OVER ON-BOARD INSTRUMENTS OF AN AES

E. N. Evlanov, V. B. Leonas, and S. V. Umansky *In* NBS Space Simulation Oct. 1970 p 186-196 refs (See N71-20201 09-11)

Avail: SOD $5.25

An apparatus for a simulation of ionospheric plasma flow over onboard instruments of an artificial earth satellite is described. The simulated fluxes of nitrogen, hydrogen and other ions have energies in the range of 5 to 100 eV, current densities of 10 to the minus 8th power A/cm, and provide good simulation of the natural working conditions of onboard instruments. A description of diagnostic means which are used for analysis of the flow parameters is given. Author

N71-20282# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.

STUDY OF THE SYNTHESIZED PLASMA RESULTING FROM FORCED NEUTRALIZATION OF A MERCURY ION BEAM [ETUDE DU PLASMA DE SYNTHESE RESULTANT DE LA NEUTRALISATION FORCEE D'UN FAISCEAU D'IONS HG(+)]

Gerard Spiess (Ph.D. Thesis - Paris Univ.) Jun. 1969 206 p refs In FRENCH

(CEA-R-3724) Avail: AEC Depository Libraries

It is shown that it is possible to obtain the forced neutralization of a low-energy Hg(+) ion beam, 10 cm in diameter, with a neutralizer made of a hot emissive filament located inside the beam close to the ion source. The computed solution of the plane-wave dispersion equation shows that the synthesized plasma, resulting from the neutralized beam, damps fluctuations with any wave length when the average ion velocity is less than the neutralizing electron thermal velocity. This last conclusion assumes that no external electromagnetic field is applied. When a longitudinal electric field is applied, by means of a polarized grid into the beam, the plasma stability range is changed. Author (NSA)

N71-20283# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Edudes Nucleaires.

CRITERIA FOR LOCAL THERMODYNAMIC EQUILIBRIUM

H. W. Drawin 1970 85 p refs Presented at the 5th Plasma Phys. Symp. and Summer School, Herceg-Novi, Yugoslavia, 6-16 Jul. 1970

(CEA-CONF-1629; CONF-700706-3) Avail: AEC Depository Libraries

The criteria of validity for local thermodynamic equilibrium (LTE) were established by considering the different terms in the zero-order Boltzmann collision equation. The conditions applicable to the establishment of a Maxwellian distribution for the free electrons were studied. It was shown that, in the most unfavorable case of an optically thin plasma, the Maxwellian distribution occurs when the degree of ionization is greater than 1 percent. Conditions become more favorable when elastic electron-atom collisions and resonance absorption are considered, and a Maxwellian distribution may be expected when the degree of ionization exceeds 0.1 percent. In the special case of heavy particles a Maxwellian distribution can generally be reached, since the particles are much less affected by inelastic collisions than the ions. NSA

N71-20376# Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes.

THOMSON SCATTERING AND RAYLEIGH SCATTERING IN AN ARGON PLASMA JET [DIFFUSION THOMSON ET DIFFUSION RAYLEIGH DANS UN JET DE PLASMA D'ARGON]

Michel Decroisette Aug. 1970 100 p refs In FRENCH

(CEA-R-3998) Avail: AEC Depository Libraries

Experimental determination of electron density in the jet nozzle of an argon plasma torch by Thomson scattering of a ruby laser beam is reported. The results are compared with those obtained from other processes (absolute continuum, absolute intensity of the Arl 4044 A line). The experimental set up makes it possible to determine the absolute value of the differential scattering cross section; it is found to be in agreement with the theoretical value. Author (NSA)

N71-20377# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Plasmaphysik.

DIGITIZING SYSTEM FOR FAST ANALOG SIGNALS

W. Hopmann and P. W. Huettemann Sep. 1970 28 p refs

(JUL-695-PP) Avail: AEC Depository Libraries

Rapid events occurring in pulsed experiments, for example in plasma physics, produce an instantaneous high rate of information to be stored in a computer memory. To overcome the limitations imposed by the memory cycle time and also to get an ADC for broadband signals, a charge storage tube system has been developed. The difficulty arising from the different shapes of the readout signal when the reading beam crosses the written trace at various angles has been overcome by integration of the read-out signal and determining the point when the half-height of the integrated signal is reached. Using commercial available tubes, a time resolution of better than 1% in the measuring time length with an accuracy of approximately 1% was achieved. Full scale step signals with a rise time of 100 nsec can be processed. Details of the system are described. Author (NSA)

N71-20378# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires.

EXPERIMENTAL STUDY OF AN ION CYCLOTRON INSTABILITY IN A MAGNETIC WELL CONFINED PLASMA [ETUDE EXPERIMENTALE D'UNE INSTABILITE CYCLOTRONIQUE IONIQUE DANS UN PLASMA CONFINE DANS UN PUITS MAGNETIQUE]

Philippe Brossier (Ph.D. Thesis - Paris Univ., 1968) Jan. 1969 170 p refs In FRENCH

(CEA-R-3680; EUR-4110) Avail: AEC Depository Libraries

Microinstabilities in macroscopically stable plasmas, in the low-beta limit are reported. Ion cyclotron instabilities, with k sub 11 = 0, have been numerically studied; the computation of the density thresholds and growth rates of the different harmonics showed the relative role played by the following: density gradient, perpendicular distribution function, and cold plasma component. This theoretical model has been compared with the results of a detailed study (density thresholds, wave structure, frequency spectrum, wavelengths, growth rate, amplitude of the electric field) of the instability observed in the DECA 2 device. This comparison gave a good agreement which shows the destabilizing role played by the cold plasma component on a hot plasma with a loss cone distribution function. Author (NSA)

N71-20465*# Avco-Everett Research Lab., Everett, Mass.

COLLISIONLESS SHOCKS IN PLASMAS

H. W. Friedman, L. M. Linson, R. M. Patrick, and H. E. Petschek Dec. 1970 45 p refs

(Contracts NASw-2040; F44620-70-C-0023)

(NASA-CR-117307; RR-363) Avail: NTIS CSCL 20I

A review of experimental and theoretical work on shock waves in plasmas where classical collisions are unimportant is presented. The role of dissipation and dispersion in determining shock structure is described and several mechanisms which can provide the required dissipation in collisionless plasmas are discussed. Observations of collisionless shocks produced in laboratory experiments as well as the earth's bow shock occurring naturally in space are described. Criteria are given when a shock may be considered thin so as to be treated as a discontinuity for flow field calculations. Author

N71-20486*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
TRAJECTORY OBSERVATIONS FOR SOME SPIRALING ELECTRON BEAM SYSTEMS
R. W. Wimarth Washington Mar. 1971 25 p refs
(NASA-TN-D-5950; C-133) Avail: NTIS CSCL 20I

A series of experiments dealing with the generation and magnetic compression of periodic electron beams are described. The behavior of these beams was studied using moveable probes and targets, as well as photographic techniques. The photographic results are significant, in that, pictures were obtained under high vacuum conditions such as normally prevail in sealed-off devices. Observations made on partially as well as completely mirrored electron beams are presented. Author

N71-20498# Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland).
EXPERIMENTAL INVESTIGATION OF THE 90 MW ROTATING MAGNETIC FIELD PINCH
A. Berney, A. Heym, F. Hofmann, and I. R. Jones Jun. 1970 46 p refs
(LRP-43/70) Avail: NTIS

The results and interpretation of measurements made on the 90 MW rotating magnetic field pinch are presented. Three standard filling pressures of 20, 60 and 180 mTorr He were chosen and the following measurements were made: (1) streak and framing photography, (2) electron line density profiles, (3) electron and ion temperatures, and detailed magnetic probe measurements. Author

N71-20507# Los Alamos Scientific Lab., N.Mex.
ONE RULE OF DIFFUSION OF A PLASMA IN STELLARATORS
I. S. Shpigel Jun. 1970 11 p refs Transl. into ENGLISH from the Russian report
(LA-TR-70-23; FIPNL-32) Avail: NTIS

Plasma confinement in stellarators was analyzed within the concepts of plasma diffusion in toroidal systems. Calculations of various cases of plasma diffusion confirmed the experimental data on linear dependence of normalization of plasma confinement time on the magnitude of the angle of transformation of the magnetic field lines. The theory of the diffusion of weak collisional plasma in toroidal axially asymmetric stellarator systems is still very new and was used in this work only for determining the diffusion coefficients as functions of the characteristics of confining field and plasma parameters. NSA

N71-20556# Purdue Univ., Lafayette, Ind. High Temperature Gas Dynamics Lab.
FLOW CALCULATIONS FOR AN ARGON ARC PLASMA SCALPEL
F. P. Incropera and R. K. Scott Jun. 1970 50 p refs
(Grant NSF GK-3383)
(HTGDL-1) Avail: Issuing Activity

Numerical calculations have been performed to determine the flow properties of the internal heating region and the external cutting flame of a unique surgical tool termed the arc plasma scalpel. The results are intended to provide an improved understanding of the scalpel performance as well as to be of future use in the interpretation of biological tissue cutting effects. The results indicate that the incision width may be minimized through a reduction of the scalpel radius and the arc current. Also, the incision depth may be increased by extending the jet-tissue interaction time, increasing the arc current and operating gas flow rate, and decreasing the scalpel radius. The radiation from the scalpel decreases with decreasing arc current but is largely independent of tube radius and operating gas flow rate. Although somewhat superficial conclusions could be drawn concerning the biological effects of tissue irradiation, more refined calculations are needed. Author

N71-20557# Purdue Univ., Lafayette, Ind. High Temperature Gas Dynamics Lab.
DESIGN AND DIAGNOSTICS OF A PROTOTYPE PLASMA ARC SCALPEL
M. A. Freeman Aug. 1970 146 p refs
(Grant NSF GK-3383)
(HTGDL-3) Avail: Issuing Activity

The design and development of a plasma jet instrument for use as a scalpel in surgical operations is discussed. An electric arc passes between the cathode and the anode, which also serves as a nozzle. The gas passes through the arc, is heated to 10,000 degrees K, and emerges as a plasmajet. Concentric with the nozzle is an annular passage through which cool gas flows. This gas cools the copper anode, minimizes contamination by providing an inert shroud for the plasmajet, and localizes the heat from the jet so that thin incisions may be made. Author

N71-20563* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MEANS FOR MEASURING THE ELECTRON DENSITY GRADIENTS OF THE PLASMA SHEATH FORMED AROUND A SPACE VEHICLE Patent
William L. Grantham, inventor (to NASA) Issued 14 Oct. 1969 (Filed 30 Jan. 1967) 5 p Cl. 324-58.5; Int. Cl. G01r27/04
(NASA-Case-XLA-06232; US-Patent-3,473,116; US-Patent-Appl-SN-612740) Avail: US Patent Office CSCL 20I

A technique for measuring the electron density gradients of the plasma sheath formed around the surface of a space vehicle as it enters or leaves a planetary atmosphere is presented. Several different frequencies are emitted into the plasma sheath and the phase difference between the transmitted energy and reflected energy is measured. This phase difference is proportional to the distance from the space craft to the critical density for each frequency. A power meter is used to measure the power of the reflected energy for each frequency to determine if the critical density boundary for the frequency exists in the plasma sheath. Official Gazette of the U.S. Patent Office

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N71-19553# Utah Univ., Salt Lake City. Dept. of Physics.
PLASMA EFFECTS IN SOLIDS AND LOW FREQUENCY EFFECTS IN SUPERCONDUCTORS Final Report
G. A. Williams Nov. 1970 5 p refs
(Grant AF-AFOSR-1602-68)
(AD-716531; AFOSR-70-2711TR) Avail: NTIS CSCL 20/12

The primary scientific results and ongoing research resulting from the Air Force Grants are summarized. Completed work includes a detailed study of Alfven-wave velocities in pure bismuth that resolves a number of discrepancies in the literature; theoretical studies of Alfvennwave attenuation in pure and doped bismuth, experimental work showing how to obtain numerical relaxation times (including quantum effects) from Alfven-wave data; and the development of an extremely sensitive technique for the measurement of energy loss in superconductors. Ongoing work generated by these grants includes low frequency energy loss in superconductors, studies of Alfven-wave attenuation in bismuth and doped bismuth, Alfven-wave velocities in doped bismuth, and heat capacity studies as a function of magnetic field in pure bismuth. Seven completed papers and several in preparation are listed. Author (GRA)

N71-19557# Little (Arthur D.), Inc., Cambridge, Mass.
GROWTH OF SAPPHIRE SINGLE CRYSTALS TRANSPARENT ARMOR BY A MODIFIED VERNEUIL TECHNIQUE Final Report
John S. Haggerty and Michael Rossetti Oct. 1970 38 p refs
(Contract DAAG46-69-C-0078)
(AD-715941; ADL-C-71490; AMMRC-CR-70-24) Avail: NTIS CSCL 19/4

The objective of the process development program was to determine whether it was feasible to produce slab shaped sapphire single crystals by a modified Verneuil technique for transparent armor applications. Seeded single crystals of sapphire were grown with widths in excess of 2 1/2 inches, lengths in excess of 2 1/2 inches and thicknesses of 3/8 inch (program goals). It was clearly demonstrated that controlled growth of high-aspect-ratio oxide single crystals by the strip Verneuil technique is feasible. An engineering cost analysis indicated that 8 inch by 1/4 inch sapphire windows could be produced at an approximate cost of $60 per pound provided reasonable yields of crack-free single crystals could be achieved. Author (GRA)

N71-19680# Rochester Univ., N.Y. Dept. of Physics and Astronomy.
OCCURRENCE OF MAGNETISM IN SUPERCONDUCTORS
K. H. Bennemann and J. W. Garland (ANL) 14 Dec. 1970 77 p refs Sponsored by AEC
(Contract N00014-67-A-0398-0004)
(AD-716027) Avail: NTIS CSCL 20/3

The authors discuss how magnetic phenomena affect superconductivity in simple metals, transition metals and alloys thereof, and dilute Rare-Earth alloys. It is shown both qualitatively and quantitatively that superconductors are sensitive probes for studying itinerant spin excitations, local spin excitations associated with nearly magnetic impurities, the effect of the atomic environment on the stability of local magnetic moments, and the nature of the spin order in Rare-Earth alloys. Also discussed is the process by which magnetic impurities can be used to study the electronic configuration responsible for superconductivity in Laves-phase crystals, such as A-15 compounds and beta-W crystals Author (GRA)

N71-19695# Rochester Univ., N.Y. Dept. of Physics and Astronomy.
VOLUME DEPENDENCE OF SUPERCONDUCTIVITY IN TRANSITION METALS AND ITS RELATION TO SUPERCONDUCTIVITY AT HIGH TEMPERATURE
K. H. Bennemann and J. W. Garland (Argonne Natl. Lab.) 14 Dec. 1970 24 p refs Sponsored in part by AEC
(Contract N00014-67-A-0398-0004)
(AD-716029; TR-2) Avail: NTIS CSCL 20/3

Formulas are given both for the volume dependence of the transition temperature Tc of transition metals and for the Tc of well-ordered A15 compounds. Both formulas yield results in reasonable agreement with experiment. Measurements are proposed to facilitate further comparison with experiment. Hopfields explanation of the high Tc of some A15 compounds is supported. Finally, it is shown why phonon-softening effects are unlikely to yield high transition temperatures for transition metals or transition-metal compounds. Author (GRA)

N71-19708# Sheffield Univ. (England). Dept. of Physics.
ELECTRONIC STRUCTURE OF METALLIC ALLOYS Final Technical Report, Jun. 1969 – Aug. 1970
N. H. March, J. S. Rousseau, and J. C. Stoddart Oct. 1970 40 p refs
(Contract DAJA37-69-C-1223)
(AD-716369; ARDG(E)-E-1258) Avail: NTIS CSCL 20/12

The problems are treated in the current report. The first, relevant to dilute metallic alloys, is concerned with the treatment of relaxation round impurities in metals. A synthesis is achieved between the method of lattice statics, which replaces the effect of the impurity by a set of Kanzaki forces acting on all other atoms in the crystal, and electron theory, which characterizes the impurity by the charge it displaces. Secondly, the theory of the influence of order on electron states in metals, described in the last Final Technical Report (AD 693 889), is applied here to calculate the electrical conductivity of a liquid metal. The theory is valid for strong scattering. It contains the Ziman theory, which is recovered when one passes to the limit of weak scattering. Author (GRA)

N71-19728*# Rensselaer Polytechnic Inst., Troy, N.Y.
SOLID STATE REACTIONS AND PHASE TRANSFORMATIONS
In its Mater. Res. Sep. 1970 p 25–36 (See N71-19726 09-32)
Avail: NTIS CSCL 20L

Solid state reactions and phase transformations were studied to alter the structure of solids in order to attain specific structures and properties. The kinetics of the martensite transformation in the Fe-C system are reported with the thermodynamic and kinetic properties of solid phase-gas phase reactions. F.O.S.

N71-19800 Yale Univ., New Haven, Conn.
STRUCTURE AND DYNAMICS OF K2ReCl6
George Patrick O'Leary (Ph.D. Thesis) 1969 166 p
Avail: Univ. Microfilms: HC $7.80/Microfilm $3.00 Order No. 70-2782

Landau's theory of second order phase transitions and the theory of lattice dynamics are combined in an approach to the understanding of the phase transitions of complex crystals. This approach is applied to the anti-fluorite system, in particular to K2ReCl6. The results of a series of crystallographic and spectrographic experiments establishing the applicability of the theoretical considerations are described. A model based on the theory is constructed and shown to describe the elementary excitations and some of the phase transitions of this system to within the accuracy of the experiments. Dissert. Abstr.

N71-19847 New York Univ., N.Y.
THE CLEBSCH-GORDAN COEFFICIENTS FOR THE CRYSTALLOGRAPHIC SPACE GROUPS
Irving Itzkan (Ph.D. Thesis) 1969 92 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 70-3078

Equations are derived for calculating the Clebsch-Gordan coefficients for the crystallographic space groups, using the procedure of inducing the irreducible representations from the ray representations of the crystallographic point groups. Examples are calculated for the wave vectors X going along the cubic axes in Rocksalt, O sub h 5 (Fm3m) and Diamond, Oh7 (Fd3m) together

with tables of Clebsch-Gordan coefficients for these cases. Also, an equation is derived for calculating the coefficients in the Clebsch-Gordan series, and hence selection rules for interaction processes in crystals, which appears to be simpler than other techniques. Dissert. Abstr.

N71-19921# Sandia Corp., Albuquerque, N.Mex. Technical Translation Service.
SOME RECENT RESULTS OF RESEARCH CARRIED OUT AT ONERA ON MECHANICS OF SOLIDS [QUELQUES RESULTATS RECENTS DES RECHERCHES EFFECTUEES A L'ONERA EN MECHANIQUE DES SOLIDES]
Roger Valid Apr. 1970 21 p refs Transl. into ENGLISH from Rech. Aerosp. (France), no. 2, Mar.–Apr. 1970 p 113–119 Presented at Natl. Conf. of Appl. Mech., Bucharest, 23–27 Jun. 1969 Sponsored by AEC
(SC-T-70-4047; CONF-690647-1) Avail: NTIS

Calculating methods are discussed for elemetary structures, such as shells and beams, working outside the elastic domain. Three-dimensional behavior laws, in plasticity as well as in creep are considered. The studies proceed along two lines: (1) development and checking of behavior laws, and (2) development of calculation methods. Author

N71-19996# Crystal Technology, Inc., Mountain View, Calif.
DEVELOPMENT OF SINGLE CRYSTAL BARIUM SODIUM NIOBATE AS A NONLINEAR OPTICAL MATERIAL Final Technical Report, 15 May 1969–15 Jun. 1970
William J. Silva, Walter E. Nelson, and Arne Rosengreen Nov. 1970 83 p refs Prepared in part by Stanford Res. Inst.
(Contract F33615-69-C-1639)
(AD-715987; AFML-TR-70-219) Avail: NTIS CSCL 20/2

Growth of barium sodium niobate single crystals by the Kyropoulos and Czochralski techniques is reported. Methods for growing single crystals under low thermal gradient conditions by the Czochralski technique are described in detail. Large c-axis boules were produced free of strain, scatter, and striae. Apparatus and techniques were developed for simultaneously poling and detwinning the crystals. Crystals grown from melts of standard, near stoichiometric, composition developed color centers. Crystals grown from niobium-deficient compositions were colorless, but highly strained. Fringe counts, transmittance as a function of applied electric field, second harmonic generation tests, and absorption measurements are described and the results are tabulated for crystals of three different compositions. Physical measurements and boule quality are correlated. Author (GRA)

N71-19997# Pennsylvania Univ., Philadelphia.
EPITAXIC SUBLIMATION METHODS FOR THE STUDY OF PSEUDO-BINARY SEMICONDUCTOR ALLOYS Semiannual Technical Report, 7 May–23 Nov. 1970
23 Nov. 1970 11 p Prepared in cooperation with NOL
(ARPA Order 1597)
(AD-716211) Avail: NTIS CSCL 20/2

The report discusses work under the contract in the following areas: Semiconductor surface electrostatics; Carrier scattering by incoherent space charge potentials; and, Fabrication of experimental apparatus and preparations to grow PbS films in ultra-high vacuum. GRA

N71-19998# Wayne State Univ., Detroit, Mich. Dept. of Physics.
MEGAHERTZ AND GIGAHERTZ ULTRASONIC ATTENUATION STUDIES IN METALS Final Technical Report
Henry V. Bohm, Robert L. Thomas, and Norman Tepley 30 Sep. 1970 9 p refs
(Grant AF-AFOSR-1494-68)
(AD-716474; AFOSR-70-2712TR) Avail: NTIS CSCL 20/12

The use of standard ultrasonic techniques at frequencies from 10MHz to 10GHz is reported together with the development and application of the new technique of direct electromagnetic sound generation to probe the electron transport properties of metals in both the normal and superconducting states. A state-dependent electron mean free path has been deduced for the superconductor mercury, and a limiting behavior at high ultrasonic frequencies is found for pure mercury which is found to be anomalous (non-BSC-like). Sophisticated data acquisition and processing methods have been applied for a detailed ultrasonic quantum oscillation study of th Spin Density Wave electronic ground state of chromium. The earlier ultrasonic work of Wallace and Bohm has been extended, results compared with existing de Haas van Alphen measurements, and evidence reported for magnetic breakdown effects. Measurements of a variety of magnetoacoustic effects at Gigahertz frequencies were made on bismuth and gallium. The possibility of a Spin Density Wave ground state of potessium has been investigated carefully, both by the deHaas - van Alphen effect and by electromagnetic sound generation. Author (GRA)

N71-20007# Battelle Memorial Inst., Columbus, Ohio.
PREPARATION AND PROPERTIES OF RARE-EARTH COMPOUNDS Semiannual Technical Report, 4 Jun.–4 Dec. 1970
V. E. Wood, K. C. Brog, A. E. Austin, J. F. Miller, and W. H. Jones, Jr. 31 Dec. 1970 46 p refs
(Contract DAAH01-70-C-1076; ARPA Order 1588)
(AD-716470) Avail: NTIS CSCL 20/3

Research was performed to investigate potentially useful properties of rare-earth materials, including studies in the areas of magnetoferroelectricity, narrow-band and narrow-gap compounds, rare-earth pinctides, and cooperative fluorescence of rare-earth ions in crystals. Manganates of Dy, Y, Ho, and Yb including high-pressure orthorhombic phases of the last three and molybdates of Eu, Gd, and Tb have been prepared and their electrical and magnetic properties studied. Electron paramagnetic resonance studies of the gradual low-temperature semiconductor-to-metal transition in Sm B6 show a resonance which tentatively has been attributed to an excited state of Sm 2 &. Author (GRA)

N71-20008# Durham Univ. (England). Dept. of Physics.
ELECTRONIC PROPERTIES OF DILUTE ALLOYS Final Report
K. N. R. Taylor 30 Nov. 1970 8 p refs
(Grant EOOAR-6-67)
(AD-716607; AFOSR-70-2836TR) Avail: NTIS CSCL 20/12

The report describes a series of extensive investigations of the physical properties of various rare earth containing systems. These have been connected mainly with the magnetic behavior of pseudobinary compounds formed between the heavy rare earth elements and the transition metals iron, cobalt and nickel. Studies have also been made of the rare earth-pinctides, predominantly with gadolinium, and of thin films of the pure heavy rare earth metals. Author (GRA)

N71-20018# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter.
EPITAXIC SUBLIMATION METHODS FOR THE STUDY OF PSEUDO-BINARY SEMICONDUCTOR ALLOYS Progress Report, 1 Jun.–30 Nov. 1970
Jay N. Zemel 10 Dec. 1970 25 p refs
(Contract N60921-70-C-0251)
(AD-716210) Avail: NTIS CSCL 20/12

The first six months have seen the initiation of: research on a variety of pseudo-binary alloy materials; a series of feasibility studies on extending existing techniques never previously employed on hetero-epitaxic films to these materials as well as considering

some other methods unique to film studies; a physio-chemical research program on the PbS-PbO alloy system; substantial progress in theoretical band structure calculations on end point materials (e.g. SnTe and CdS); a reformulation of the APW program to simplify future calculations. Of the five materials under study, four are being prepared routinely as epitaxic films. The evaporation system for the fifth material is rapidly approaching completion. Measurement equipment has been ordered where needed and some initial progress has been made in testing these materials. Author (GRA)

N71-20022# Brandeis Univ., Waltham, Mass. Dept. of Physics.
COMPARISON OF THE MOESSBAUER EFFECT TO TIME DIFFERENTIAL PERTURBED ANGULAR CORRELATIONS: THE CASE OF Fe 57 IN A Ni HOST
C. Hohenemser [1970] 16 p refs Presented at 6th Moessbauer Symp., Chicago, 25 Jan. 1970 Submitted for publication Sponsored by AEC
(CONF-700114-1) Avail: NTIS

The time differential perturbed angular correlation (TDPAC) technique was applied to hyperfine interactions in the Fe-57-Ni impurity/host system. The TDPAC results, and Mossbauer results from the same system are compared. It is concluded that although both methods share certain common aspects, there are important differences in the two methods which give one or the other a distinct advantage in different applications. Author

N71-20023# Bendix Corp., Kansas City, Mo.
BEAM LEAD SEMICONDUCTOR TESTING AND HANDLING
L. W. Smith Sep. 1970 11 p refs
(Contract AT(29-1)-613)
(BDX-613-194) Avail: NTIS

Testing and handling processes for beam lead semiconductor devices are discussed. Environmental tests were performed by bonding devices to a substrate and placing two substrates in an edge connector. Only six devices per substrate were used; however, the method could be expanded to larger substrates. The method, while satisfactory for environmental testing, must be considered destructive since the devices are bonded to the substrate. Author

N71-20094# Naval Ordnance Lab., White Oak, Md.
THE OPTICAL ABSORPTION SPECTRUM OF GdCl3-6H2O
Hermenzo D. Jones 19 Nov. 1970 39 p refs
(AD-716040; NOLTR-70-170) Avail: NTIS CSCL 7/4

An elementary analysis of the crystal-field splittings, Zeeman Effect, and line strengths for the magnetic dipole transitions for GdCl3-6H2O is presented. It is assumed that the environment of the gadolinium ion can be represented by a static electric field. The crystal-field calculation is based on the hypothesis that the ion is at a site of pseudo-cylindrical symmetry. A fit of the data for the sextet P 7/2 and sextet P 5/2 levels yields B2(0) = −281.70/cm and B2(2) = −75.42/cm for the crystal field parameters. The intermediate-coupling g values are in close agreement with those calculated from the observed sum rules of the Zeeman splittings. Author (GRA)

N71-20231# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
EQUIPMENT TO STUDY HIGH VELOCITY DISLOCATIONS IN MATERIALS
V. R. Parameswaran and J. Weertman *In* NBS Space Simulation Oct. 1970 p 487-508 refs Sponsored by ARPA (See N71-20201 09-11)
Avail: SOD $5.25

The motion of a shock front consisting of an array of high speed dislocations through the shock loaded material was studied. An equipment was constructed to shock load single crystals of metals by shooting small steel pellets using a gas gun. The slip bands generated on the surface of the crystals by the stress pulses give a measure of the dislocation mobility in the material. The equipment used to produce the stress pulses and that used to measure and record the stress pulses are described. Author

N71-20423 Rensselaer Polytechnic Inst., Troy, N.Y.
MAGNETIC TUNNELING IN CRYSTALS IN ONE AND TWO BAND MODELS USING THE EFFECTIVE HAMILTONIAN METHOD
Joseph Hariton Zablotney (Ph.D. Thesis) 1969 146 p
Avail: Univ. Microfilms: HC $7.00/Microfilm $3.00 Order No. 70-2662

Tunneling phenomena in crystals in a uniform magnetic field are examined in models of single and coupled bands. Two single band models with the special characteristic that their band structures have a saddle point are investigated. The models differ in the symmetry of the energy contours around the saddle point. Exact energy level structures calculated by numerical methods are compared with those predicted and show small discrepancies. Interband breakdown in a two band model having the characteristics of a hexagonal metal is also examined. Dissert. Abstr.

N71-20438 Oregon Univ., Eugene.
CRYSTAL GROWTH AND GALVANOMAGNETIC PROPERTIES OF Mg2Pb
Gene Arthur Stringer (Ph.D. Thesis) 1969 91 p
Avail: Univ. Microfilms: HC $4.80/Microfilm $3.00 Order No. 70-2543

The electrical transport properties of the intermetallic compound Mg2Pb are studied and applied to the determination of the Fermi surface and band structure of this cubic semimetal. A method of crystal growth is described which produced single crystal samples of Mg2Pb. A Bridgman method is used, starting with a non-stoichiometric melt (<31.3 at. % Pb). Measurements of the angular dependence of the magneto-resistance and the magnetic field dependence of the Hall coefficient in fields up to 5200 gauss and at temperatures of 4.2 and 77 K suggests the presence of two bands of holes similar to p-type Ge. Finally, a qualitative analysis of the field dependence of the magnetoconductivity tensor shows that Mg2Pb is a semimetal and suggests that there are three carrier species contributing to electrical transport, two hole bands and one electron band. Dissert. Abstr.

N71-20499# Stanford Univ., Calif. Microwave Lab.
PSEUDO-GREEN'S FUNCTIONS AND THE PSEUDOPOTENTIAL THEORY OF d-BAND METALS
John A. Moriarty Feb. 1971 55 p refs
(Grant NSF GP-9450)
(ML-1930) Avail: Issuing Activity

A general one-electron pseudo-Green's function formalism is developed as an extension of the true Green's function techniques of Anderson. Pseudo-Green's function equations are derived in an arbitrary, overcomplete basis representation for a general non-Hermitian pseudo-Hamiltonian. The flexibility in the choice of both the basis set and the pseudopotential makes the method useful for treating a variety of physical systems. Formal calculations of the pseudo-Green's function and the density of states are considered for simple metals as well as d-band metals. The method is applied in detail to the case of a d-band metal. Using a basis set of plane waves and localized d-states, calculations of the electron screening field and the total energy are performed. These quantities are found as a function of both the pseudo-potential and Harrison's hybridization parameter. Overlap between d-states enters in the total energy and is explicitly included. Author

N71-20504# Mound Lab., Miamisburg, Ohio.
LATTICE ENERGY CALCULATIONS FOR THE ALKALI HYDRIDES

R. C. Bowman, Jr. 21 Dec. 1970 21 p refs
(Contract AT(33-1)-Gen-53)
(MLM-1764) Avail: NTIS

A systematic investigation of the alkali hydride lattice energies was made for the ionic Born – Mayer potential. Data from gaseous diatomic molecules and crystalline lithium hydride were used in the calculations. Models included second neighbor interactions and van der Waals forces. Calculated lattice energies consistently agreed with experimental values, which qualitatively substantiated the ionic nature of alkali hydride bonds. The Born – Mayer parameters determined in this study will be useful in calculating the defect properties of the alkali hydrides. Isothermal compressibility calculations agree within 10% of reported experimental and theoretical estimates. Author

N71-20506 Rensselaer Polytechnic Inst., Troy, N.Y.
ANHARMONIC PROPERTIES OF SOLIDS AND ULTRASONIC BEAM MIXING
Russell W. Dunham (Ph.D. Thesis) 1969 201 p
Avail: Univ. Microfilms: HC $9.25/Microfilm $3.00 Order No. 70-2663

A technique for studying quantitively the anharmonic properties of solids by ultrasonic beam mixing has been developed. Measurements are made of the conversion efficiency for mixing reaction. In fused silica, a typical isotropic solid, the ratio of the conversion efficiency of the above reaction was measured for transverse waves polarized respectively parallel and perpendicular to the interaction plane as a function of the input frequency ratio. The values of the third order elastic constants, A and B, (in Taylor – Rollins nomenclature) were determined from the best fit to the experimental data. Dissert. Abstr.

N71-20547# Scientific Translation Service, Ann Arbor, Mich.
STUDY OF MONOCHROMATOR CRYSTALS FOR NEUTRONS HAVING A LATTICE DISTANCE GRADIENT, PART 1
F. Rustichelli 1970 26 p refs Transl. into ENGLISH from the Italian Report Prepared for Oak Ridge Natl. Lab.
(ORNL-TR-2401; EUR-4414) Avail: NTIS

A theoretical analysis of the utilization as neutron monochromators of crystals with a gradient of lattice spacing is given. The possibility of utilizing such crystals in composite monochromator systems is investigated. The techniques used to produce crystals with a gradient of the lattice spacing and the first experimental results are described. Author (NSA)

N71-20579# Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes.
PRESSES: HYDROSTATIC AND ISOSTATIC PRESSING [PRESSES: PRESSAGE HYDROSTATIQUE ET ISOSTATIQUE]
Elisee Moulet Aug. 1970 71 p refs In FRENCH and ENGLISH
(CEA-Bib-187) Avail: AEC Depository Libraries

Selected documentary references concerning presses and hydrostatic and isostatic pressing are presented. The period covered is from 1935 to 1969 inclusive. Indexes are included on authors, subjects, periodicals, reports, patents, congress, and books. Author (NSA)

N71-20580# Kentucky Univ., Lexington. Dept. of Physics and Astronomy.
ELECTRON HOLE RECOMBINATION TIME IN A METAL Progress Report
B. R. Gossick [1970] 16 p refs
(Contract AT(40-1)-3651)
(ORO-3651-7) Avail: NTIS

The electron-hole recombination time of metals, determined from measurements of the properties of ohmic contacts reported earlier, is surprisingly large (approximately .0001 sec), as also is the characteristic diffusion length (approximately 1 mm). It follows that the excess carrier densities at an ohmic metal-semiconductor boundary are not in general negligible but instead may be appreciable under suitable conditions. Author

N71-20581# California Univ., Berkeley. Lawrence Radiation Lab.
CRYSTAL AND MOLECULAR STRUCTURE OF SODIUM GOLD(I) THIOSULFATE DIHYDRATE
Helena Ruben, Allen Zalkin, M. O. Faltens, and David H. Templeton Oct. 1970 17 p refs
(Contract W-7405-eng-48)
(UCRL-19985) Avail: NTIS

X-ray diffraction study of a single crystal of Na3 Au(S2O3)2-2H2O shows that it is monoclinic with a = 18.206 + or – 0.006, b = 11.355 + or – 0.006, c = 5.436 + or – 0.004A and beta = 97.87 + or – 0.05 deg. The space group is P2 sub 1/a with four formula units per unit cell. The X-ray density is 3.14g/sq cm. The gold is located between the two thiosulfate groups in a near linear arrangement (S-Au-S, 176.5 deg). The average Au-S bond distance is 2.28 + or – .01A, the S-S distance is 2.06 + or – 01A while the S-O distance is 1.46 + or – .01A. The three sodium atoms are surrounded by irregular polyhedra of oxygen neighbors. Author

N71-20582# California Univ., Berkeley. Lawrence Radiation Lab.
STRAIN-RATE EFFECTS
Dale Klahn, Amiya K. Mukherjee, and John E. Dorn Sep. 1970 32 p refs Presented at 2d Intern. Conf. on the Strength of Metals and Alloys, Pacific Grove, Calif., 30 Aug. – 4 Sep. 1970
(Contract W-7405-eng-48)
(UCRL-20320; CONF-700819-7) Avail: NTIS

A brief review of several known types of deformation mechanisms is presented. Major emphasis, however, is directed toward the synthesis and unification of strain-rate effects arising from the simultaneous operation of several mechanisms. In particular, attempts are made to estimate theoretically dislocation velocities and plastic strain rates over wide ranges of stress and temperature. The need for improvements in theory and its extension into new and relatively unexplored regions are pointed out in passing. Finally the theoretical deductions are compared with experimental results on damping capacity, dislocation velocities, and plastic strain rates. Author

N71-20600# Naval Research Lab., Washington, D.C.
COMPUTER PROGRAM FOR THE CALCULATION OF THE CRYSTAL STRUCTURE INVARIANTS BASED ON CERTAIN CONDITIONAL DISTRIBUTIONS Final Report
Janet E. Fisher, J. Harrison Hancock, and Herbert A. Hauptman 7 Dec. 1970 27 p refs
(AD-716746; NRL-7157) Avail: NTIS CSCL 20/2

Effective techniques leading from the values of the crystal structure invariants to the values of the individual phases have recently been obtained. In the present report a new formula expressing the structure invariants in terms of the observed crystal structure amplitudes is given, and a computer program is described which facilitates the computation of the invariants. Author (GRA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N71-20116# National Aerospace Lab., Tokyo (Japan).
EXPERIMENTAL INVESTIGATION OF MONOPROPELLANT HYDROGEN PEROXIDE REACTOR
Shohki Shimizu and Toshiharu Tanemura 1970 17 p refs In JAPANESE; ENGLISH summary
(NAL-TR-202) Avail: NTIS

The effect of catalyst on the decomposition efficiency, pressure loss, start transient, and lifetime of a monopropellant hydrogen peroxide in a reactor is investigated. The reactor produces 10 kg thrust at a chamber pressure of 20 kg/sq cm. Hydrogen peroxide, in a concentration of 90 percent decomposes through the catalyst bed with a diameter of 30 mm and lengths up to 75 mm. Various kinds of catalysts including silver screens, silver pellets, samarium oxide-coated silver screens and stainless-steel screens were tested. The samarium oxide as a promoter improves the decomposition efficiency and start transient. The initial temperature of the catalyst bed and the propellant have a very strong influence on the start transient. The use of stainless-steel screens enhances the thermal decomposition of hydrogen peroxide, although it causes some penalty in the whole system. In a reactor with silver pellet catalysts, ignition delay is extremely short, even at the cold bed start and the decomposition efficiency is considerably lowered. Author

N71-20477*# Aerojet Solid Propulsion Co., Sacramento, Calif. Advanced Technology Operations.
DEVELOPMENT OF NONDESTRUCTIVE TEST TECHNIQUES FOR LARGE SOLID PROPELLANT GRAINS Final Report
J. M. Amaral and B. L. Lamb 24 Mar. 1971 239 p refs
(Contract NAS3-12036)
(NASA-CR-72840) Avail: NTIS CSCL 21I

A nondestructive testing (NDT) system based on a through transmission ultrasonic technique and a combination of film and scintillation radiography is defined for large solid propellant grains. A microwave scanning technique is described for inspection of propellant during casting of the grain. Investigation was preceded by a failure mode analysis (FMA) and a survey of available NDT techniques. The most promising techniques were comparatively evaluated by application to a specimen representative of the finned section of a full-length 260-in. dia motor containing critical flaws as determined by the FMA. Author

N71-20505# Bureau of Mines, Bartlesville, Okla.
RADIOTRACER STUDY OF TURBINE AIRCRAFT FUEL STABILITY
M. L. Whisman, F. O. Cotton, J. W. Goetzinger, and C. C. Ward Mar. 1971 34 p refs
(BMRI-7493) Avail: Issuing Activity

A radiotracer method for detecting the contribution of selected components and additives to thermally induce deposits of turbine aircraft fuels is discussed. Fuels were examined before and after 52 weeks of storage at 130 F. Of particular concern was the influence of aromatic hydrocarbon fuel constituents on thermal-stability quality of jet fuels during storage. A microfuel coker test apparatus was used to thermally stress the test fuels and blends, and the resultant contribution to deposits of selected fuel components, labeled with carbon-14, was determined by radioactive-counting techniques. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N71-19369# General Electric Co., Cincinnati, Ohio.
AIRFRAME/PROPULSION SYSTEM INTEGRATION ANALYSIS USING THE PROPULSION SIMULATOR TECHNIQUE
John T. Kutney *In* AGARD Aerodyn. Interference Jan. 1971 21 p refs (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

The propulsion simulator technique was conceived to provide the analysis and evaluation of the total system performance in the wind tunnel of the new high bypass turbofan installations. This technique provides simultaneous simulation of the induction system and the exhaust system flows with correct geometric simulation and allows the total aircraft aerodynamics and the propulsion system interactions to be evaluated together without the use of additional or reference models. Examples of these data are presented including comparison of a C5A type scale model and full scale results of the TF39/B52 installation. The use of this technology for advanced programs of airframe engine integration for both the subsonic and supersonic flight spectrums is discussed. Author

N71-19373# Boeing Co., Seattle, Wash. Supersonic Transport Div.
CONFIGURATION ASPECTS OF PROPULSION INSTALLATION ON SUPERSONIC TRANSPORTS
Albert A. Van Duine, William W. Rhoades, and Walter C. Swan *In* AGARD Aerodyn. Interference Jan. 1971 8 p (See N71-19353 09-01)
Avail: NTIS HC$6.00/MF$0.95

Intake decision closely related to configuration effects are outlined for supersonic transport applications. The general problems of propulsion pod placement and proper integration of pod and wing are discussed. The effects of wing flow field and aircraft maneuvers on intake performance and intake operating envelope are treated. Intake-to-intake and intake-to-wing spacing criteria are established relative to mutual intake interference and wing/body boundary layer effects. Finally, a propulsion comparison is made between a variable sweep configuration employing double engine pods and a fixed wing configuration employing single engine pods. Author

N71-19451*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AIRCRAFT PROPULSION
Washington 1971 463 p refs Conf. held at Cleveland, 18–19 Nov. 1970
(NASA-SP-259) Avail: NTIS HC$6.00/MF$0.95 CSCL 21A

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10. EFFECTS OF ENGINE INLET DISTURBANCES ON ENGINE STALL PERFORMANCE J. H. Povolny, F. W. Burcham, Jr., J. E. Calogeras, C. L. Meyer and R. A. Rudey p 313–341 refs (See N71-19461 09-28)

11. DYNAMICS AND CONTROL A. S. Boksenbom, G. L. Cole, D. I. Drain, K. W. Hiller, R. G. Willoh et al p 351–395 refs (See N71-19462 09-28)

12. CRYOGENIC FUELS FOR AIRCRAFT J. B. Esgar p 397–420 refs (See N71-19463 09-21)

13. ADVANCEMENTS IN BEARINGS, SEALS, AND LUBRICANTS E. V. Zaretsky and L. P. Ludwig p 421–463 refs (See N71-19464 09-15)

N71-19452*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

FAN AND COMPRESSOR TECHNOLOGY

Melvin J. Hartmann, William A. Benser, Cavour H. Hauser, and Robert S. Ruggeri *In its* Aircraft Propulsion 1971 p 1–36 refs (See N71-19451 09-28)

Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

Fans and compressors for advanced engines are described. The compressor of a turbojet engine requires a number of high pressure ratio stages. A low bypass ratio turbofan engine may require two or three stages in the fan. For high bypass ratio engines, the fan pressure ratio is low and single-stage fans may be adequate. Some of the general requirements of fans and compressors are listed. As usual, high component efficiency is essential for low specific fuel consumption. Light weight is generally desirable for all applications. Light weight may be achieved by using high pressure stages so that fewer stages are required to achieve the required pressure. Light weight materials and advanced construction techniques must also be used. Fans and compressors must operate over a wide range of flows and must tolerate inlet flow distortions that may occur during some portions of the flight. Low noise limits may require the selection of specific rotational speeds and blade loadings. Even with suitable selection of these parameters, considerable noise suppresion may be required. Author

N71-19453*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TURBINE AERODYNAMIC CONSIDERATIONS FOR ADVANCED TURBINES

Thomas A. Moffitt, Stanley M. Nosek, and Richard J. Roelke *In its* Aircraft Propulsion 1971 p 37–55 refs (See N71-19451 09-28)

Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

Advanced engines offer many interesting challenges to the turbine designer. For example, the continuing trend to higher temperature complicates the problem of effectively cooling the turbine. Another example is the trend in fan engines toward higher bypass ratios. These trends create special problems for the turbines that drive these fans. Some of the turbine aerodynamic work to study two of these problem areas is presented. Author

N71-19454*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TURBINE COOLING RESEARCH

Herman H. Ellerbrock and Reeves P. Cochran *In its* Aircraft Propulsion 1971 p 57–96 refs (See N71-19451 09-28)

Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

Turbine cooling for application to aircraft gas turbine engines at gas temperatures up to about 4000 F and gas pressures up to about 600 psia is discussed. Present facilities permit experimental research at gas temperature and pressure of about 2500 F and 125 psia, respectively. The purposes of this paper are threefold, namely, (1) to discuss the objectives of the turbine cooling probram, (2) to indicate how and with what facilities the research is conducted, and (3) to present some results that have been obtained. Author

N71-19455*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMBUSTION

Jack Grobman, Robert E. Jones, Cecil J. Marek, and Richard W. Niedzwiecki *In its* Aircraft Propulsion 1971 p 97–134 refs (See N71-19451 09-28)

Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

The latest engine operating conditions affecting the problems in combustor design are reviewed. The research approaches being used to solve these problems are discussed. By way of review, the various criteria that are used in the design of gas turbine combustors are considered. Author

N71-19456*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

V/STOL PROPULSION

Newell D. Sanders, James H. Diedrich, James L. Hassell, Jr., David H. Hickey, Roger W. Luidens et al *In its* Aircraft Propulsion 1971 p 135–168 (See N71-19451 09-28)

Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

The propulsion technology for commercial airplanes designed for short takeoff and landing (STOL) or for vertical takeoff and landing (VTOL) is described. Some differences between these airplanes and conventional takeoff and landing (CTOL) airplanes are illustrated by the trajectories. A greater demand for engine thrust, or lift, exists from CTOL to STOL and to VTOL airplanes. Values of engine thrust to airplane gross weight might be as follows: (1) CTOL airplanes, 0.3; (2) STOL airplanes, 0.6, and (3) VTOL airplanes, 1.2. The desired thrust of the STOL airplane is double the thrust of the CTOL airplane. The VTOL airplane requires another doubling of the thrust. These values are generalizations; they are intended to convey a sense of magnitude only. Author

N71-19458*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LOW COST ENGINES FOR AIRCRAFT

Robert L. Cummings and Harold Gold *In its* Aircraft Propulsion 1971 p 211–231 (See N71-19451 09-28)

Avail: NTIS HC $6.00/MF $0.95 CSCL 21A

The very high cost of current gas turbine engines which substantially restricts their use is discussed. The approximate cost of several current general aviation engines are shown. The general aviation light plane must be suitable for a retail sales price of around $30,000 for a single-engine aircraft and $45,000 for a light twin-engine aircraft. For the high flight speeds, a 425-horsepower engine would be required, but the price of over $17,000 is already too high. The currently available turbojet, turboshaft, and fanjet engines are much too costly, with prices ranging from $22,000 to over $65,000. The competitive impact of a really low-cost gas turbine engine with a 1000-pound static sea level thrust having a total manufacturing price of $6000, or $6 per pound of thrust is described. Such an engine would provide important performance gains for light aircraft and also have a very important price advantage over either current piston engines or current jet engines. In order to sell at 1/5 the price per pound of thrust of current jet engines, however, this engine would require really major design simplifications and manufacturing cost reduction. Author

N71-19459*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SUPERSONIC EXHAUST NOZZLES

Milton A. Beheim, Bernhard H. Anderson, John S. Clark, Blake W.

Corson, Jr., Leonard E. Stitt et al *In its* Aircraft Propulsion 1971 p 233–282 refs (See N71-19451 09-28)
Avail: NTIS HC$6.00/MF$0.95 CSCL 21A

A major problem in the design of an exhaust system for a supersonic airplane is that its geometrical shape should change as flight conditions are changed. The sonic area and expansion ratio must be variable, and it might also be required to reverse thrust and to suppress jet noise or infrared radiation. The mechanisms that are needed to do this can be complicated and heavy. Therefore, there is a trade between weight and performance that depends on the mission. The missions for supersonic aircraft can be divided into the following types: (1) Supersonic cruise, such as the B-70, SR-71, and the supersonic transport and (2) Supersonic dash, such as the B-58, F-4, F-111, B-1, F-14, and F-15. The supersonic dash aircraft fly long distances subsonically but are also able to go supersonic for relatively short distances. Exhaust nozzle concepts for both types of aircraft are considered in this section. Supersonic cruise nozzle are discussed first, and then some of the supersonic dash problems are described. Author

N71-19460*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUPERSONIC CRUISE INLETS
David N. Bowditch, Robert E. Coltrin, Bobby W. Sanders, Norman E. Sorensen, and Joseph F. Wasserbauer *In its* Aircraft Propulsion 1971 p 283–312 refs (See N71-19451 09-28)
Avail: NTIS HC$6.00/MF$0.95 CSCL 21A

For supersonic cruise at Mach numbers greater than 2, one of the inlet parameters that affects these important inlet charactistics is the internal contraction of the supersonic diffuser. The performance of several inlets to show how the amount of internal contraction affects their characteristics is discussed. Not only those inlet characteristics that can be measured in terms of range are considered, but also inlet characteristics such as angle-of-attack tolerance which are more difficult to evaluate. In addition, methods to improve the stability of the internal contraction inlets and some typical distortions that have been measured during wind tunnel testing are described. Author

N71-19461*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF ENGINE INLET DISTURBANCES ON ENGINE STALL PERFORMANCE
John H. Povolny, F. W. Burcham, Jr., James E. Calogeras, Carl L. Meyer, and Richard A. Rudey *In its* Aircraft Propulsion 1971 p 313–341 refs (See N71-19451 09-28)
Avail: NTIS HC$6.00/MF$0.95 CSCL 21A

The operating limits of propulsion systems may restrict the capabilities of both subsonic and supersonic aircraft. One such limit of gas turbine propulsion systems is compressor stall or surge. The performance and operating limits of the engine, especially the compressor system, are influenced by the flow conditions at the engine inlet. This leads to the necessity of adequately matching the inlet and engine so that the capabilities of the aircraft are not compromised by the condition of the flow supplied by the inlet to the engine or the susceptibility of the engine compressor system to this flow. It should be noted that, in addition to the inlet design parameters, the condition of the flow is also determined by external influences such as armament firing, flight maneuvers, thrust reversal, inlet unstart, inlet buzz, some of which cause temperature as well as pressure disturbances. In order to better understand the flight environmental disturbances and their effects on the operating limits of turbine engines, research programs are being conducted. Data obtained from these programs are presented. Author

N71-19462*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DYNAMICS AND CONTROL
Aaron S. Boksenbom, Gary L. Cole, Daniel I. Drain, Kirby W. Hiller, Ross G. Willoh et al *In its* Aircraft Propulsion 1971 p 361–395 refs (See N71-19451 09-28)
Avail: NTIS HC$6.00/MF$0.95 CSCL 21E

Major problems in dynamics and controls of a supersonic propulsion system are presented. The job of the control (inlet control, engine control, and coupling signals between the inlet and the engine) is to avoid severe, damaging, or unstable conditions throughout the system. They also maintain system operation at the desired or optimum condition and, when required, move the system from one operating point to another. To design such controls requires an understanding of the dynamic, as well as the static, performance of all system components. Author

N71-19488# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
POWER PLANTS FOR AIRCRAFT WITH AIR-BREATHING ENGINES
V. I. Polikovskii and D. N. Surnov 22 Oct. 1970 351 p refs Transl. into ENGLISH of the book "Silovye Ustanovki Letatelnykh Apparatove Svosdushno-Reaktivnymi Dvigatelyami" 1965 p 1–261
(AD-716496; FTD-HC-23-595-69) Avail: NTIS CSCL 21/5

The textbook supplies the necessary information for planning the basic systems of a modern aircraft power plant with an air-breathing jet engine. The aspects of engine operation in an aircraft are compared with the conditions of its operation on a stand, and the general requirements that apply to the power plant and its systems are derived. Separate chapters are devoted to the fuel systems, air intake and exhaust systems, and systems for scavenging and engine cooling. Author (GRA)

N71-19682# Princeton Univ., N.J. Dept. of Electrical Engineering.
THE CLASSIFICATION OF ENGINE VIBRATION RECORDS THROUGH QUASI-SINGULAR DETECTION
Geng-Seng Fang and Theodosios Pavlidis Dec. 1970 35 p refs (Contract DAHC04-69-C-0035; Grant NSF GK-13622)
(AD-716600; TR-33; AROD-8244.5-A) Avail: NTIS CSCL 20/1

The report deals with the classification of signals in term of their autocorrelation functions. Such an approach is necessary for the classification of vibration records from reciprocating internal combustion engines because the mean of such records contains no significant information. For each signal the autocorrelation is calculated for a narrow window. The eigenfunctions of each class are determined and an unknown signal is classified by comparing the norms of its projections to subsets of such eigenfunctions. By working with eigenfunctions corresponding to the smallest eigenvalues the method approximates singular detection.. Author (GRA)

N71-19779*+ TRW Systems Group, Redondo Beach, Calif.
SIZING DATA FOR MULTIPLE STAGES, EXPENDED AND REUSABLE OPERATING MODES, TABULAR LISTING OF CONFIGURATION DELTA V CAPABILITIES, APPENDIX A Project Technical Report, Task E-94
R. J. Bratkowski 25 Feb. 1971 106 p
(Contract NAS9-8166)
(NASA-CR-114903; TRW-17818-H111-R0-00-App-A) Avail: NTIS CSCL 21H

The one way Delta V increments theoretically obtainable from each of nine different one and two stage propulsive configurations are listed. Payload delivery retrieval, and roundtrip operating modes are considered. A specific impulse value of 460 seconds was selected to typify engine performance. Delta V magnitudes are shown for propellant mass fractions from 0.80 to 0.95 and payload to stage weight ratios from 0 to 10. Author

N71-19986# Sandia Corp., Albuquerque, N Mex. Aerothermodynamics Projects Dept.

PERFORMANCE AND FLIGHT CHARACTERISTICS OF THE SANDHAWK FAMILY OF ROCKET SYSTEMS
Gerald G. Wilson and William A. Millard [1969] 36 p refs Supported by AEC
(SC-DC-70-4757A) Avail: NTIS

Performance and flight characteristics are summarized for the single stage Sandhawk, the advanced Terrier (BT3) Sandhawk 13, the advanced Terrier (BT3) Sandhawk 17, and the Dualhawk 9. Typical aerodynamic coefficients and vehicle stability data are discussed. E.C.

N71-20019# Aeronautical Research Labs., Melbourne (Australia).
EROSION BY PARTICLE IMPACT: EXPERIMENTS WITH CALLIDE COAL ASH
G. Brasinikas Jul. 1970 31 p refs
(ARL/ME-315) Avail: NTIS

In support of a research programme into the feasibility of operating a gas turbine on coal, the erosion rate produced on representative turbine blade materials by the ash from Callide coal has been investigated in a laboratory rig. The effect of angle of incidence, mean ash particle size, temperature, metal properties and particle velocity on the erosion rate has been determined over a range of conditions relevant to a gas turbine. Author

N71-20050*# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
SMOKE EMISSION FROM JET ENGINES
Lawrence H. Linden and John B. Heywood Oct. 1970 32 p refs Sponsored in part by NSF
(Grant NGR-22-009-378)
(NASA-CR-117031; FML-70-12) Avail: NTIS CSCL 21E

The fundamental processes determining the amount of smoke in the exhaust of a gas turbine engine are examined. The configuration of modern combustors and the processes occurring within the combustor are reviewed. Data from laboratory flame studies of carbon formation are then discussed and correlated with engine and combustor exhaust studies. It is seen that solid carbon is the nonequilibrium product of fuel vapor-air combustion in locally fuel rich zones. Calculations of carbon oxidation rates are then used to show that significant fractions of the carbon formed in the rich regions of the primary zone may be consumed in the leaner regions of the primary zone and in the secondary zone. Finally, combustor design features desirable for minimal exhaust smoke are summarized. Author

N71-20063# Lockheed-Georgia Co., Marietta.
OPTIMISING THE PROPULSIVE/LIFT SYSTEM FOR TURBOFAN STOL AIRCRAFT CONSIDERING COST EFFECTIVENESS
H. T. Bowling *In* AGARD Assessment of Lift Augmentation Devices Feb. 1971 14 p (See N71-20051 09-02)
Avail: NTIS

The results are presented of a comparison of three STOL high lift concepts which have been integrated with bypass-ratio turbofan engines. Transport aircraft configurations optimized using these concepts are compared along with significant characteristics of each system. The purpose of this comparison was to provide possible insight for future studies and testing. None of these systems were subjected to a highly detailed analysis and do not represent completely optimized concepts. Every effort was made to make the comparison as consistent as possible. A secondary purpose is the discussion and demonstration of a study methodology which was developed to integrate cost effectiveness into the early technical development of new airplane concepts. This methodology is primarily applied to a military STOL development program. However, some examples are shown of considerations of commercial cost effectiveness. Author

N71-20173*# Rocketdyne, Canoga Park, Calif.
GENERALIZED PROPULSION SYSTEM MODEL FOR NASA MANNED SPACECRAFT CENTER, HOUSTON, TEXAS Final Report
John J. Boehnlein 11 Mar. 1971 225 p refs
(Contract NAS9-10319)
(NASA-CR-114915; R-8445) Avail: NTIS CSCL 21H

The Generalized Propulsion System Model which is a digital computer program designed to study transient performance of pressure fed rocket engine systems is presented. Analytical techniques which could be used to characterize the behavior of pressure-fed rocket engines were evaluated. The selected techniques were programmed for solution on a digital computer, and after debugging, the necessary manuals and guides were written for use with the program. The program was demonstrated by modeling the Apollo ascent and descent engines, and the pressurization system of Rocketdyne's SE5-5 engine system. The program was successful operated on the NASA, Houston Univac 1108 computer. Author

N71-20291*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FULL SCALE TESTS OF A SHORT LENGTH, DOUBLE ANNULAR RAM INDUCTION TURBOJET COMBUSTOR FOR SUPERSONIC FLIGHT
Porter J. Perkins, Donald F. Schultz, and Jerrold D. Wear Washington Mar. 1971 41 p refs
(NASA-TN-D-6254; E-5899) Avail: NTIS CSCL 21E

A 40-in. diameter combustor 20.25 in. in length gave performance equalling or exceeding that of a similar combustor 50 percent longer. Tests were with inlet-air at 1150 F and 90 psia at 1050 F and 60 psia, and at 600 F (589 K) and 90 psia, with 2200 F (1478 K) exit temperatures. Combustion efficiency was 100 percent, exit temperature profiles were good, and no visible smoke was measured. At cruise and takeoff, pattern factors were 0.20 and 0.25, and pressure loss 8.4 percent and 6.2 percent, respectively. Blowout limits, altitude relight, and response to rapid increase in fuel flow were measured over a wide operating range. Durability was satisfactory for 100 hr although some metal burning occurred at the 1150 F inlet temperature. Author

N71-20330# Curtiss-Wright Corp., Wood-Ridge, N.J.
GAS TURBINE COMBUSTION APPARATUS Patent
Ralph J. Sneeden, inventor (to NASA) Issued 18 Mar. 1969 (Filed 23 Jun. 1965) 11 p Cl. 60-39.36; Int. Cl. F02g1/00, 3/00; Int. Cl. F02c3/00 Sponsored by NASA
(NASA-Case-XLE-10347-1; US-Patent-3,433,015; US-Patent-Appl-SN-466390) Avail: US Patent Office CSCL 21E

The design and characteristics of a combustion apparatus for a gas turbine engine are presented. The apparatus consists of a gas turbine unit in which the turbine nozzle guide vanes are used to introduce substantially all of the diluent air into the combustion gases. Mixing of the diluent air with the combustion gases produces a uniform temperature of the resulting gases both circumferentially and radially thus avoiding regions of excessive temperature in the combustion gases. Official Gazette of the U.S. Patent Office

N71-20347# National Aerospace Lab., Tokyo (Japan).
INVESTIGATION OF COMBUSTION PERFORMANCE OF TURBOJET COMBUSTOR
Teikichi Otsuka, Shoji Horiuchi, and Kokichi Homma 1970 37 p refs In JAPANESE; ENGLISH summary
(NAL-TR-204) Avail: NTIS

Combustion performances of turbojet combustor models were studied varying inlet-air pressure, temperature and velocity independently. Characteristics of the combustion performance such as combustion efficiency and temperature distribution in the combustion zone were obtained for different air-entry hole arrangements and fuel nozzles of the can-type combustors. Author

N71-20348# Sheffield Univ., (England). Dept. of Fuel Technology and Chemical Engineering.
COMBUSTION INSTABILITY IN SOLID PROPELLANT ROCKET MOTORS Final Report
J. Swithenbank Oct. 1969 173 p refs
(HIC-100) Avail: NTIS

Irregular pressure peaks in solid propellant rockets are accompanied by pressure oscillations at acoustic frequencies. The chain of cause and effect relating these two phenomena was investigated and as a result, various means of inhibiting the unstable combustion are proposed. A 6" diameter rocket motor fitted with a window was used for the experimental investigation, and it was confirmed that severe pressure oscillations give rise to acoustic streaming effects in the cavity. In the case of the travelling tangential mode, this takes the form of a single transonic vortex whose axis coincides with the axis of the chamber. When this swirling flow passes through the nozzle, the effective area of the throat is reduced by up to 40%, and consequently, the equilibrium chamber pressure rises up to six times above its design level. Analysis shows that the presence of a single transonic vortex interferes with the propagation of tangential travelling waves to the extent that waves travelling in the same direction as the vortex are annihilated, and only waves travelling in the opposite direction are permitted. Autho

N71-20403*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
STUDY OF INDUCER LOAD AND STRESS, VOLUME 1 Final Report
31 Dec. 1970 288 p refs
(Contract NAS3-11216)
(NASA-CR-72712-Vol-1; PWA-FR-3704-Vol-1) Avail: NTIS CSCL 21H

A program of analysis, design, fabrication and testing has been conducted to develop computer programs for predicting rocket engine turbopump inducer hydrodynamic loading, stress magnitude and distribution, and vibration characteristics. Methods of predicting blade loading, stress, and vibration characteristics were selected from a literature search and used as a basis for the computer programs. An inducer, representative of typical rocket engine inducers, was designed fabricated, and tested with special instrumentation selected to provide measurements of blade surface pressures and stresses. Data from the tests were compared with predicted values and the computer programs were revised as required to improve correlation. Author

N71-20404*# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.
STUDY OF INDUCER LOAD AND STRESS, VOLUME 2 Final Report
31 Dec. 1970 181 p refs
(Contract NAS3-11216)
(NASA-CR-72712-Vol-2; PWA-FR-3704-Vol-2) Avail: NTIS CSCL 21H

Computer programs have been developed to predict inducer blade pressure loading, stress distribution, and vibration characteristics. The analytical and experimental program conducted to develop the computer programs is described. The three computer programs, hydrodynamic, stress and vibration, and information for the user are provided. Included are input and output formats, instructions for their use and a sample case to serve as a guide for each of the programs. Author

N71-20415*# Aerojet Liquid Rocket Co., Sacramento, Calif.
STABILITY CHARACTERIZATION OF ADVANCED INJECTORS. DESIGN GUIDE. VOLUME 2: OPERATION OF THE COMPUTER PROGRAM, PHASE 3 Final Report
R. C. Waugh Feb. 1970 425 p refs Revised
(Contract NAS8-20672)
(NASA-CR-117057; Rept.-20672-P3D-Rev.-A) Avail: NTIS HC $6.00/MF $0.95 CSCL 21H

CONTENTS:

1. PROBLEM, PROGRAMMING, AND DECK SETUP 337 p refs (See N71-20416 09-28)
2. ANALYSIS OF THE LOW FREQUENCY STABILITY OF A GAS-TAPOFF CYCLE USING GASEOUS HYDROGEN AND GASEOUS OXYGEN 51 p (See N71-20417 09-12)
3. ANALYSIS OF THE LONGITUDINAL HIGH FREQUENCY STABILITY OF A STAGED COMBUSTION CYCLE 31 p refs (See N71-20418 09-33)

N71-20416*# Aerojet Liquid Rocket Co., Sacramento, Calif.
[PROBLEM, PROGRAMMING, AND DECK SETUP]
In its Stability Characterization of Advanced Injectors, Design Guide, Vol. 2 Feb. 1971 337 p refs (See N71-20415 09-28)
Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

The tools by which the analyst may characterize the combustion stability of a system are presented. The combustion model which provided the basis for this analytical technique is the Sensitive Time Lag theory. A description of a computer program, written in FORTRAN 5, which may be utilized in characterizing a variety of combustion systems is provided. The program has been updated to include a high Mach number analysis. Author

N71-20419*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SMOKE EVALUATION OF A MODIFIED J-57 COMBUSTOR
Jack Grobman and Leonidas C. Papathakos Washington Mar. 1971 38 p refs
(NASA-TM-X-2236; E-6005) Avail: NTIS CSCL 21E

An experimental investigation was conducted to reduce smoke emission from a J-57 turbojet engine burning ASTM A-1 fuel by making modifications to the primary zone of the combustor. Tests were performed with a single J-57 combustor liner that was installed in a 12-inch-diameter pipe. Mixing and percentage airflow in the primary zone were increased by varying the geometry of combustor dome and liner air-entry openings. The final modification reduced the smoke number from 64 to 24 at simulated takeoff conditions (combustor inlet total pressure, 12.3 atm). This was accompanied by a significant reduction in altitude relight capability. Author

N71-20420*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUMMARY OF COLD-AIR TESTS OF A SINGLE-STAGE TURBINE WITH VARIOUS STATOR COOLING TECHNIQUES
Thomas P. Moffitt, Herman W. Prust, Jr., Edward M. Szanca, and Harold J. Schum [1971] 22 p refs Presented at the 16th Ann. Intern. Gas Turbine Conf. and Prod. Show, Houston, Tex., 28 Mar.–1 Apr. 1971; sponsored by the Am. Soc. of Mech. Engr.
(NASA-TM-X-52968) Avail: NTIS CSCL 21E

The results of a series of cold-air tests of the aerodynamic effects of coolant on turbine performance are presented. Annular stator exit surveys and single-stage tests were made of a 30-inch diameter turbine using three simulated coolant types of stator blading. The first ejected coolant into the mainstream through a slot in the blade trailing edge. The other two were of the porous skin type, one utilizing a self-supporting shell with discrete holes for variable porosity, and the other a wire mesh skin wrapped around an internal support strut with individual metering orifices and supply passages. Results are presented in terms of stator exit wake traces, stator efficiencies, stage efficiencies, and rotor efficiencies. Author

N71-20500*# Aerojet-General Corp., Sacramento, Calif.
STABILITY CHARACTERIZATION OF ADVANCED

INJECTORS, PHASE 3 Final Report
Feb. 1971 59 p refs
(Contract NAS8-20672)
(NASA-CR-117033; Rept.-20672-P3F) Avail: NTIS CSCL 21H

The transverse mode stability characteristics of coaxial and HIPERTHIN injectors were studied in a transverse excitation chamber. The transverse excitation chamber is a research tool developed to evaluate the response of injectors to purely transverse modes of instability. In addition, the Sensitive Time Lag Theory was extended to include operation at high Mach numbers. An investigation of the stability characteristics of gaseous oxygen/gaseous hydrogen propellants at moderate and low chamber pressures (300 and 15 psia) is included. Author

N71-20501*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AN IMPROVED METHOD FOR MAXIMIZING THE PAYLOAD OF ELECTRIC PROPULSION SPACECRAFT AT LOW POWER LEVEL
Charles L. Zola Feb. 1971 14 p refs
(NASA-TM-X-52980; E-6196) Avail: NTIS CSCL 21C

A technique for improving the payload at low power is proposed which involves reducing the total mass of the spacecraft. It is shown that an optimum total mass of the electric propulsion spacecraft can be less than the maximum injected mass capability of the chemical-rocket launch vehicle at any given injection velocity. An example of the method is given for a Mercury orbiter mission using a solar-electric-propulsion spacecraft launched by a Titan 3D/Centaur. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N71-19534# Cornell Univ., Ithaca, N.Y. Lab. of Nuclear Studies.
STUDY OF COSMIC GAMMA RADIATION Final Technical Report, 1 Feb. 1967 - 31 Aug. 1970
Kenneth I. Greisen and John P. Delvaille 30 Sep. 1970 18 p refs
(Grant AF-AFOSR-255-67)
(AD-716492; AFOSR-70-2466TR) Avail: NTIS CSCL 4/1

Research performed under the grant is summarized, consisting of two main components: balloon flights of a large spark chamber in search of discrete sources of gamma rays with energy above 700 MeV, and development of a very large gamma-ray telescope, 4.6 square meters in sensitive area, utilizing Cerenkov radiation in a low-pressure gas to detect gamma rays above 150 MeV with good angular resolution and excellent background rejection. The spark chamber flights detected no sources yielding more than 0.000005 gammas per square centimeter-sec. An apparent source of about this strength, close to the location of M87, may be a statistical fluctuation. Properties of the Cerenkov telescope and its behavior in sea level tests are summarized, but termination of the grant occurred before flights of the instrument could be carried out. Author (GRA)

N71-19951# Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany). Inst. fuer Geophysik und Meteorologie.
THE FOERSTER SONDE AND THE INDUCTION COIL EXPERIMENTS OF THE SOLAR PROBE HELIOS. PART 1: EXPERIMENTAL CONDITIONS AS SEEN BY SCIENTIFIC RESEARCH [DAS FOERSTERSONDEN- UND DAS INDUKTIONS-SPULENEXPERIMENT DER SONNENSONDE HELIOS. TEIL 1: FORDERUNGEN AN DIE EXPERIMENTE AUS DER SICHT DER WISSENSCHAFTLICHEN FORSCHUNG]
F. M. Neubauer 1969 27 p refs In GERMAN
Avail: NTIS

Helios probe instrumentation for the continuous observation of interplanetary magnetic field flux as function of distance from the sun is described. A magnetic sensing system with digital resolution and an induction coil experiment are used to determine high frequency regions in the kinetic scale as well as the fine structures of interplanetary shock waves and tangential discontinuities. Obtained magnetic field component measurements and field profiles in connection with passing shock waves are presented. Transl. by G.G.

N71-20025# Universidad Mayor de San Andres, La Paz (Bolivia). Cosmic Physics Lab.
NEUTRON MONITOR (NM-64) DATA, JULY 1968 - MARCH 1969 [MONITOR DE NEUTRONES (NM-64), JULIO 1968 - MARZO 1969]
R. Anda, G. R. Mejia, and M. Zubieta Nov. 1969 25 p In SPANISH
(Rept.-34) Avail: NTIS

The data obtained by the neutron monitor: NM-64, at Monte Chacaltoya for the period July, 1968 to March, 1969 are presented. Tabulated hourly observations, and graphs of daily variations for each month are included. Transl. by F.O.S.

N71-20026# Universidad Mayor de San Andres, La Paz (Bolivia). Cosmic Physics Lab.
AN INVESTIGATION IN COSMIC PHYSICS [LA INVESTIGACION EN FISICA COSMICA]
G. R. Mejia May 1969 71 p refs In SPANISH
Avail: NTIS

A history on the development of cosmic physics is presented with an analysis of the role of the Monte Chacaltaya Laboratory in developing cosmic radiation science. The relation of cosmic physics to stellar, solar, and nuclear physics is also discussed. Transl. by F.O.S.

N71-20159# California Univ., Irvine. Dept. of Physics.
COSMIC RAY NEUTRINO EXPERIMENT
W. G. Sandie, P. B. Landecker, D. Bourne (Univ. of Witwatersrand, Africa), M. F. Crouch (Case-Western-Reserve Univ., Cleveland, Ohio), J. Lathrop et al [1970] 29 p refs Presented at the 6th Interam. Seminar on Cosmic Rays, La Paz, Bolivia Sponsored in part by AEC
(UCI-10-P-19-38; CONF-700708-1) Avail: NTIS

Preliminary results from the detector located deep underground on Level 77 of the East Rand Proprietary Mine near Johannesburg are presented. The array is described and a summary of results to date is given, including the total exposure and running time and the distribution of events in zenith angle. A few sample events are described. Author (NSA)

N71-20160# Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes.
STUDY OF THE FAR DISTANT DEVELOPMENT OF AIR MASSES LABELED BY A NUCLEAR EXPLOSION AND ENCOUNTERED BY A CONSTANT LEVEL BALLOON IN THE SOUTH PACIFIC [ETUDE DE L'EVOLUTION A GRANDE DISTANCE DES MASSES D'AIR MARQUEES PAR UNE EXPLOSION NUCLEAIRE ET RENCONTREES PAR UN BALLON PLAFONNANT DANS LE PACIFIQUE SUD]
Andre Doury Nov. 1970 32 p refs In FRENCH
(CEA-R-4093) Avail: AEC Depository Libraries

On September 3 and 4, 1968 a chance encounter arose in the South Pacific between a constant level balloon carrying out solar X-ray measurements at 100 mb, and radioactive air masses from a recent nuclear test. The trajectories of the different elements of these air masses were established over several days and a few orders of magnitude given on the predicted radioactivity levels, the circumstances of the encounter, and the levels and form of the signals transmitted by the balloon. The movements of the clouds and the balloon are considered in the three dimensions of space and the uncertainties of position and altitude are discussed. Conclusions are drawn concerning the significance of information provided by constant level balloons, particularly the possibilities of checking the calculated trajectories, dimensions, and contamination levels of radioactive clouds developing at a great distance. Author (NSA)

N71-20218*# Hughes Research Labs., Malibu, Calif. Ion Device Physics Dept.

ANALYSIS OF THE SIMULATION OF THE SOLAR WIND

D. E. Zuccaro *In* NBS Space Simulation Oct. 1970 p 261–277 refs (See N71-20201 09-11)

(Contract NAS2-5585)

(NASA-CR-117140) Avail: NTIS; SOD $5.25 CSCL 03B

The properties of the solar wind are surveyed, a set of requirements for solar wind simulation is established and a conceptual design of a simulator system is developed. The significant features of the design are the following: (1) the protons are formed in an RF excited plasma discharge ion source; (2) a 20 deg deflection magnetic mass separator is used to purify the proton beam of other ions, energetic charge exchange neutrals, and Lyman alpha photons; (3) the use of a small diameter beam permits differential pumping of the ion source and the sample chamber and; (4) the proton beam either can be expanded to flood the sample, or it can be scanned over the sample. Author

N71-20219*# Hughes Aircraft Research Labs., Malibu, Calif. Propulsion Technology Section.

SOLAR WIND SIMULATOR

H. J. King *In* NBS Space Simulation Oct. 1970 p 279–296 refs (See N71-20201 09-11)

(Contract NAS2-5585)

(NASA-CR-117141) Avail: NTIS; SOD $5.25 CSCL 03B

Thermal control coating materials are exposed to a proton flux in order to estimate the stability of their reflective and absorptive properties when exposed to the solar wind. The ion source, mass separator, and beam transport system which make up an experimental apparatus to perform these tests are discussed. A final system design is presented which is capable of irradiating 10 standard samples 2 cm in diameter with a proton beam ranging in energy from 0.5 to 3.0 KeV and in intensity from 1 to 1000 times that of the nominal solar wind. Author

N71-20385# Aerospace Corp., El Segundo, Calif. Space Physics Lab.

FURTHER RESULTS ON A O(VII) X-RAY CORONAL LINE EMISSION Technical Report, May–Oct. 1970

Hugo R. Rugge and Arthur B. C. Walker, Jr. 14 Dec. 1970 13 p refs

(Contract F04701-70-C-0059)

(AD-716472; TR-0059(9260-02)-4; SAMSO-TR-70-430) Avail: NTIS CSCL 3/2

Measurements of the intensity ratio of O VII solar x-ray emission lines were made during a three-day period in 1969. The results are essentially the same as obtained from a different satellite during an extended period in 1966/1967. These results lead to an upper bound on the coronal electron density from the regions emitting the O VII radiation of approximately 5x10 to the 9th power/cc. Author (GRA)

N71-20408*# Scientific Translation Service, Santa Barbara, Calif.

INVESTIGATION OF PROTON FLUX IN THE 1.5 - 50 MeV RANGE ON AUTOMATIC INTERPLANETARY STATIONS ZOND-4 AND ZOND-5 [ISSLEDOVNAIYE POTOKOV PROTONOV V DIAPAZONE 1.5 - 50 MEV NA AMS ZOND-4 I ZOND-5]

B. P. Konstantinov et al Washington NASA Mar. 1971 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Leningrad), v. 34, no. 11, 1970 p 2250–2254

(Contract NASw-2035)

(NASA-TT-F-13509) Avail: NTIS CSCL 03B

Proton fluxes in the 1.5 - 50 MeV range were studied on Zond-4 and Zond-5. The apparatus used for their observations is described, and the obtained results are discussed. Author

N71-20409*# Scientific Translation Service, Santa Barbara, Calif.

CHANGE IN THE DEGREE OF NONREGULARITY OF THE INTERPLANETARY MAGNETIC FIELD WITH THE CYCLE OF SOLAR ACTIVITY [IZMENENIYE STEPENI NEREGULYARNOSTI MEZHPLANETNOGO MAGNITNOGO POLYA S TSYKLOM SOLNECHNOY AKTIVNOSTI]

A. I. Kuz'min et al Washington NASA Mar. 1971 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 34, no. 11, 1970 p 2419–2425

(Contract NASw-2035)

(NASA-TT-F-13514) Avail: NTIS CSCL 03B

Properties of the first and second spherical harmonics of cosmic ray distribution are used to study the changes of the interplanetary field with solar activity cycle. It is found that field nonregularity undergoes great changes in the large scale region, but is smaller in the small scale region. Author

N71-20410*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

HYDROGEN LINE BLANKETED MODEL STELLAR ATMOSPHERES

D. A. Klinglesmith Washington 1971 264 p refs

(NASA-SP-3065) Avail: NTIS CSCL 03B

Theoretical results are compiled that provide an internally consistent set of model atmospheres for comparison with observations. Enough data on the depth-dependent quantities are given so that other quantities can be easily computed. The observable quantities presented are monochromatic emergent fluxes, discontinuities, continuum slopes, UBV and uvby colors, and equivalent width and central intensity of H gamma. Author

N71-20411*# Scientific Translation Service, Santa Barbara, Calif.

ANTISYMMETRIC DIURNAL AND SEMIDIURNAL VARIATIONS OF COSMIC RAYS [ANTISIMMETRICHNAYA SUTOCHNAYA I POLUSUTOCHNAYA VARIATSII KOSMICHESKIKH LUCHEY]

P. A. Krivoshapkin et al Washington NASA Mar. 1971 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Leningrad), v. 34, no. 11, 1970 p 2379–2385

(Contract NASw-2035)

(NASA-TT-F-13513) Avail: NTIS CSCL 03B

The diurnal and semidiurnal variations of cosmic rays are analyzed. It is found that the gradient mechanism cannot explain the seasonal variations in these antisymmetric variations of cosmic rays. Author

N71-20412*# Scientific Translation Service, Santa Barbara, Calif.

MEASUREMENTS OF THE ENERGY SPECTRA OF MULTI-CHARGED NUCLEI ON THE SATELLITE KOSMOS-225 [IZMERENIYA ENERGETICHESKIKH SPEKTROV MNOGOZARYADNYKH YADER NA SPUTNIKE KOSMOS-225]

L. V. Kurnosova et al Washington NASA Mar. 1971 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Leningrad), v. 34, no. 11, 1970 p 2265–2269
(Contract NASw-2035)
(NASA-TT-F-13511) Avail: NTIS CSCL 03B

Energy spectra of multi-charged nuclei were measured and plotted according to hardness. The results of the measurements were compared with other data, and certain deviations were found. Author

N71-20467*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LARGE SCALE PROPERTIES OF THE INTERPLANETARY MAGNETIC FIELD
Kenneth H. Schatten Mar. 1971 84 p refs Submitted for publication
(NASA-TM-X-65467; X-692-71-96) Avail: NTIS CSCL 03B

Large-scale properties of the interplanetary magnetic field are reviewed. The early theoretical work of Parker is presented along with the observational evidence supporting his Archimedes spiral model. The discovery of interplanetary magnetic sectors is reviewed. The variations present in the interplanetary magnetic field from the spiral angle are related to structures in the solar wind and the relationship of the solar magnetic field to the interplanetary magnetic field is also discussed. Author

N71-20468*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SHELL SPLITTING DUE TO ELECTRIC FIELDS
David P. Stern Mar. 1971 9 p refs Submitted for publication
(NASA-TM-X-65466; X-641-71-90) Avail: NTIS CSCL 03B

Drift shells of trapped particles starting from a single field line in the earth's magnetic field may become separated due to an electric field. Using the formalism of the shell splitting function, this separation is calculated for an arbitrary curl-free time-independent electric field with no limitation on the particle's longitudinal excursion. The effect of non-dipole field components is also taken into account to the lowest order. Author

N71-20469*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MICROSTRUCTURE OF THE INTERPLANETARY MEDIUM
L. F. Burlaga Mar. 1971 75 p refs Submitted for publication
(NASA-TM-X-65468; X-692-71-100) Avail: NTIS CSCL 03B

The microstructure of the solar wind and its relationship to the large scale interplanetary medium are reviewed. The solar wind is described in terms of hydromagnetic waves and discontinuities. Considered are: (1) the predominant directions of observed discontinuities; (2) the power spectra levels due to discontinuities; (3) Alfven waves or other structures; (4) the relation of microscale fluctuations to beta; and (5) the definition of filaments. G.G.

N71-20472*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CONTRIBUTIONS TO X-RAY PHYSICS IN SPACE
Klaus Schocken 27 Jan. 1971 62 p refs
(NASA-TM-X-64571) Avail: NTIS CSCL 03A

Continuous X-radiation in space that originates as blackbody radiation, deceleration radiation, and by inverse Compton processes is discussed. It is shown that the radiation in Tau X-1 originates as synchrotron radiation, in Cyg X-2 and Sco X-1 as deceleration radiation, and the diffuse background radiation by inverse Compton processes. The hypothesis is made that the background X-ray flux in the galaxy consists partly of synchrotron X-rays that are generated in a galactic dynamo. Synchrotron radiation from the galaxy has been observed at radio frequencies. The radio emission of the galaxy provides evidence that magnetic fields extend far beyond the boundaries of the galaxy proper into a corona which is called the halo. Maintenance of the synchrotron radiation of the Crab Nebula by magnetic fields is attributed to the dynamo theory. The radio and optical pulsar NP 0532 is also an X-ray pulsar close to the center of the Crab Nebula. It is shown that pulsar properties can be explained if the falling core of a collapsing star rebounds as assumed in an oscillating model of the universe. Author

N71-20485# Observatoire de Paris (France).
SYNOPTIC CHARTS OF THE SOLAR CHROMOSPHERE AND FILAMENT CENTERS AND ACTIVITY CENTERS, VOLUME 5, PHASE 2, 1968–1969 [CARTE SYNOPTIQUES DE LA CHROMOSPHERE SOLAIRE ET CATALOGUES DES FILAMENTS ET DES CENTRES D'ACTIVITE, VOLUME 5, FASCICULE 2, 1968–1969]
1970 58 p In FRENCH
Avail: NTIS

Synoptic data from 20 solar activity cycle observations are reported. The data were gathered over a period of 11 years. Activity centers and chromospheric filaments for each of the 27 Carrington rotations observed during this period are contained in two catalogs. Transl. by G.G.

N71-20490*# Scientific Translation Service, Santa Barbara, Calif.
CHARGE DISTRIBUTION OF HEAVY NUCLEI OF COSMIC RAYS IN THE REGION z > OR ~ TO 26 [O ZARYADOVOM RASPREDELENII TYAZHELYKH YADER KOSMICHESKIKH LUCHEY V OBLASTI z BOLSHE CHEM ILI RAVNO K 26]
N. S. Ivanova et al Washington NASA Mar. 1970 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk. SSSR, Ser. Fiz. (Leningrad), v. 34, no. 11, 1970 p 2255–2258
(Contract NASw-2035)
(NASA-TT-F-13510) Avail: NTIS CSCL 03B

The photoemulsion method was used to study the charge composition of heavy primary nuclei. Exposure of the emulsion stacks was carried out at an altitude of 300 km outside the magnetic field of the earth. Preliminary evaluations of the results are presented and their significance is discussed. Author

N71-20641# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
THEORETICAL GALACTIC COSMIC RAY ELECTRON SPECTRUM OBTAINED FOR SOURCES OF VARYING GEOMETRY
Moses Elias Cohen May 1969 50 p refs
(CEA-R-3674(E)) Avail: AEC Depository Libraries

An electron density energy spectrum of galactic cosmic rays using an arbitrary circular cylindrical source is presented, without restriction to a galactic disc. The integrals are treated exactly. An exponential energy variation was obtained which was not observed experimentally. Models of elliptic cylindrical and ellipsoidal galactic disc sources are also discussed. It is noted that a very large source concentrated in a very small region gives a spectrum not unlike that for a small source distributed throughout a large volume. Author (NSA)

N71-20676*# Techtran Corp., Glen Burnie, Md.
STELLAR SPECTRA IN THE LABORATORY [ASTROSPEKTRY V LABORATORII]
L. A. Mitrofanova Washington NASA Mar. 1971 19 p refs Transl. into ENGLISH from Priroda (Moscow), no. 5, May 1970 p 31–38
(Contract NASw-2037)
(NASA-TT-F-13520) Avail: NTIS CSCL 03C

A method of modelling planetary atmospheres in an absorption cell and possible applications of the technique are discussed. The laboratory equipment used in several experiments and the approaches to solving the problem which several researchers have taken are described. Author

N71-20576*# Scientific Translation Service, Santa Barbara, Calif.
PRINCIPLES OF THE MECHANISM OF A SCIENTIFIC INSTRUMENT FOR STUDYING HIGH ENERGY COSMIC RAYS ON THE SPACE STATION PROTON 4 [PRINTSIPY USTROYSTVA NA NAUCHNOY APPARATURY DLYA IZUCHENIYA KOSMICHESKIKH LUCHEY VYSOKOY ENERGII NA KOSMICHESKOY STANTSII PROTON 4]
V. V. Bugakov et al Washington NASA Mar. 1971 21 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 34, no. 9, 1970 p 1818–1828
(Contract NASw-2035)
(NASA-TT-F-13533) Avail: NTIS CSCL 03B

The flux of high- and ultrahigh-energy particles in outer space is discussed. Instruments are described for measuring nuclear-proton interactions and for detecting quarks in primary cosmic radiation. A description is given of the ionization calorimeter, the charge and radiation detectors and the targets, as well as of the operating principles of the ionization calorimeter IC-15. Finally, the structural characteristics of the IC-15 are given to include the ionization chambers, proportional counters, detector units, targets and filters. The article is accompanied by drawings depicting these instruments and graphs of their characteristics. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N71-19412*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRACKING AND DATA SYSTEM SUPPORT FOR THE PIONEER PROJECT: PIONEER 6 EXTENDED MISSION, 1 JULY 1966–1 JULY 1969, VOLUME 5
N. A. Renzetti 1 Feb. 1971 120 p refs
(Contract NAS7-100)
(NASA-CR-117050; JPL-TM-33-426-Vol-5) Avail: NTIS CSCL 22C

CONTENTS:
1. PIONEER PROJECT AND PIONEER 6 MISSION, PART 1 p 1–11 (See N71-19413 09-30)
2. EXTENDED FLIGHT PHASE, PART 2 FIRST ANNUAL PERIOD, 1 JUL. 1966–1 JUL. 1967 p 13–35 (See N71-19414 09-30)
3. EXTENDED FLIGHT PHASE, PART 3 SECOND ANNUAL PERIOD, 1 JUL. 1967–1 JUL. 1968 p 37–67 (See N71-19415 09-30)
4. EXTENDED FLIGHT PHASE, PART 4 THIRD ANNUAL PERIOD, 1 JUL. 1968–1 JUL. 1969 p 69–100 (See N71-19416 09-30)

N71-19413*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PIONEER PROJECT AND PIONEER 6 MISSION, PART 1
In its Tracking and Data System Support for the Pioneer Proj.: Pioneer 6 Extended Mission, 1 Jul. 1966–1 Jul. 1969, Vol. 5 1 Feb. 1971 p 1–11 (See N71-19412 09-30)
Avail: NTIS CSCL 22C

Tracking and data acquisition support, and scientific events and measurements are discussed. Details are given on the Deep Space Network capability for two-way communication; the Pioneer telemetry system to generate two-way Doppler measurements and its earth-to-space command capability to control the spacecraft subsystems and science payload; the extended flight phase support requirements resulting from increased life expectation of Pioneer 6; and the advanced antenna system facility at Goldstone, California. Special coverage was given Pioneer 6 during occultations and syzygys, and solar events, magnetosheath, and bow shock were investigated. The celestial mechanics, cosmic ray telescope, cosmic ray anistropy detector, plasma cup detector, quadrispherical plasma analyses, magnetometer, and radio propagation experiments are described. N.E.N.

N71-19414*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EXTENDED FLIGHT PHASE, PART 2 First Annual Period, 1 Jul. 1966–1 Jul. 1967
In its Tracking and Data System Support for the Pioneer Proj.: Pioneer 6 Extended Mission, 1 Jul. 1966–1 Jul. 1969, Vol. 5 1 Feb. 1971 p 13–35 (See N71-19412 09-30)
Avail: NTIS CSCL 22C

Engineering and operation activities of the Pioneer 6 for the period 1 July 1966 through 1 July 1967 are discussed. Significant events, changes in project requirements, and the overall performance of the DSN are reviewed. A hydrostatic thrust bearing problem caused shutdown for six weeks, and correction of the problem is described. The RF performance data are presented in graphs and tables, and tracking data for the passes over DSS 14 are outlined. N.E.N.

N71-19415*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EXTENDED FLIGHT PHASE, PART 3 Second Annual Period, 1 Jul. 1967–1 Jul. 1968
In its Tracking and Data System Support for the Pioneer Proj.: Pioneer 6 Extended Mission, 1 Jul. 1966–1 Jul. 1969, Vol. 5 1 Feb. 1971 p 37–67 (See N71-19412 09-30)
Avail: NTIS CSCL 22C

Engineering and operation activities of the Pioneer 6 for the period 1 July 1967 through 1 July 1968 are discussed. The most serious problem was the loss of the ability to track the spacecraft in a two-way coherent mode, and for a period two-way noncoherent tracking was performed. The most significant improvement was transfer of the DSS 14 antenna to an ultracone configuration, which provided tracking at a bit rate of 8 bits/sec with low parity error rate readings. The RF performance data are presented in graphs and tables, and tracking data for the passes over DSS 14 are outlined. N.E.N.

N71-19416*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EXTENDED FLIGHT PHASE, PART 4 Third Annual Period, 1 Jul. 1968–1 Jul. 1969
In its Tracking and Data System Support for the Pioneer Proj.: Pioneer Extended Mission, 1 Jul. 1966–1 Jul. 1969, Vol. 5 1 Feb. 1971 p 69–100 (See N71-19412 09-30)
Avail: NTIS CSCL 22C

Engineering and operation activities of the Pioneer 6 for the period 1 July 1968 through 1 July 1969 are discussed. Spacecraft solar occultation and full superior conjunction with the sun occurred. The spacecraft was physically occulted from 21 to 25 November, and no signals were received between 17 and 29 November. Observation of high level solar activity during March and April 1969 were observed by Pioneers 6,7,8, and 9. The RF performance data are presented in graphs and tables, and tracking data for the passes over DSS 14 are outlined. N.E.N.

N71-19778*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
LUMINESCENCE OF APOLLO 11 AND 12 LUNAR SAMPLES. LUNAR SAMPLE ANALYSIS PROGRAM
Norman N. Greenman and H. Gerald Gross Mar. 1971 27 p refs
(Contract NAS9-7966)
(NASA-CR-114899) Avail: NTIS CSCL 03B

Luminescence measurements of Apollo 11 and 12 samples have been made with far, middle, and near ultraviolet radiation, X-rays, protons, and electrons. Efficiencies were found to be low, of the order of 0.000001 or less, for all irradiations except low

energy protons, where efficiencies were of the order of 0.0001. These cannot account for the astronomical observations of luminescence on the moon, at least not in the Apollo 11 and 12 landing areas and at least to the extent that our samples are representative. In general, the efficiencies agree well with those for terrestrial rocks in which efficiencies decrease with increasing basic characters. No evidence from measurements of both interior and exterior specimens was found that micrometeorite impact, space radiation, and other mechanisms operating at the lunar surface have affected the luminescence character of the rocks. Such effects, if present, are too small to be seen through the mask of low luminescence efficiency and consequent weak signals. Author

N71-19780*# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.

OPTICAL PROPERTIES OF APOLLO 12 MOON SAMPLES

Frank Briggs and Brian O'Leary Jan. 1971 24 p refs Submitted for publication

(Contract NAS9-8018)

(NASA-CR-114894; CRSR-420) Avail: NTIS CSCL 03B

The photometric-phase function, color, normal albedo, polarimetric phase function, and spectrophotometry of the Apollo 12 soil are presented. In general, the optical properties of the Apollo 12 soil are very similar to those of the Apollo 11 soil and of lunar mare surfaces in general. Significant differences are that the Apollo 12 soil is 20 per cent brighter and considerably redder than the Apollo 11 soil. These may be explained by the presence of material comprising a ray of the crater Copernicus. Author

N71-19781*# IIT Research Inst., Chicago, Ill.

APPLICATION OF THE MOESSBAUER TECHNIQUE TO THE STUDY OF PROBABLE LUNAR AND PLANETARY SURFACE MATERIAL AND TO THE STUDY OF RETURNED LUNAR SURFACE SAMPLES Final Report

C. L. Herzenberg, D. L. Riley, and R. B. Moler Feb. 1971 23 p refs

(Contract NAS 9-8083)

(NASA-CR-114887; IITRI-V6005-4) Avail: NTIS CSCL 03B

Nuclear gamma resonance measurements show that iron is generally abundant in Apollo 12 lunar samples, and is predominantly in the ferrous state. Substantial differences among the spectra of Apollo 12 crystalline rocks indicate considerable diversity in the phase distribution of iron, reflecting significant differences in modal mineralogy. Two different magma types are distinguished on the basis of Mossbauer analyses. Mossbauer analyses indicate that Apollo 12 rocks are generally olivine rich and ilmenite poor, with respect to Apollo 11 crystalline rocks. Spectra of various Apollo 12 soils are remarkably similar to each other, but different from Apollo 11 soil spectra, suggesting that the Mossbauer spectra provide regional soil signatures. Ilmenite and metallic iron are less abundant, and olivine more abundant in Apollo 12 soils relative to Apollo 11 soils. Possible evidence for a resonance associated with the cryptic component in the fines was found. Author

N71-19782*# Chicago Univ., Ill. Enrico Fermi Inst.

NEUTRON ACTIVATION ANALYSIS FOR TRACE ELEMENTS. ELEMENTS DEPLETED ON LUNAR SURFACE: IMPLICATIONS FOR ORIGIN OF MOON AND METEORITE INFLUX RATE Final Report, 1 Aug. 1969 - 31 Jan. 1971

Edward Anders, J. C. Laul, Reid R. Keays, R. Ganapathy, and John W. Morgan 1971 11 p refs Presented at Apollo 12 Lunar Sci. Conf., Houston, Tex., 11 - 14 Jan. 1971

(Contract NAS9-7887)

(NASA-CR-114888; EFI-71-2; COO-382-109) Avail: NTIS CSCL 03B

Compared to terrestrial basalts and eucrite meteorites, Apollo 11 and 12 basalts are consistently depleted in siderophile elements (Ir, Pd, Ag, Au) and volatile elements (Zn, Cd, In, Tl, Bi, Br), by factors of 0.1 to 0.01. The depletion of siderophiles suggests that the Earth and Moon segregated their metal and silicate in two discrete events, contrary to the fission hypothesis. All soil and breccia samples are enriched in elements thought to be largely of meteoritic origin: Ag, Au, Bi, Br, Cd, Ir, Te, Tl, and Zn. The enrichment pattern in most samples is dominated by material of C 1 chondrite composition, probably micrometeorites of cometary origin. The average abundance is 1.9% C 1 material or equivalent, and the average meteorite influx rate is 4×10 to the minus 9th power g/sq cm/ year. Soil samples collected on crater rims, and some Apollo 12 breccias, show a smaller amount of meteoritic material, of less primitive composition. Apparently Bench, Head, and Surveyor Craters at the Apollo 12 site were made by ordinary chondrites or irons. An anorthosite sample from Apollo 11 soil shows a similar pattern. Author

N71-19784*# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.

PHYSICAL PROPERTIES OF THE APOLLO 12 LUNAR FINES

T. Gold, B. T. O'Leary, and M. Campbell Jan. 1971 21 p refs

(Contract NAS9-8018)

(NASA-CR-114893) Avail: NTIS CSCL 03B

The size distribution of the lunar fines was measured, and small but significant differences were found between the Apollo 11 and 12 samples as well as among the Apollo 12 core samples. The optical and the radio frequency electrical properties were measured and were also found to differ only slightly from Apollo 11 results. Author

N71-19786*+ California Univ., Berkeley. Space Sciences Lab.

ANALYTICAL TECHNIQUES FOR IDENTIFICATION AND STUDY OF ORGANIC MATTER IN RETURNED LUNAR SAMPLES Semiannual Report, 1 Oct. 1969 - 31 Mar. 1969

1969 71 p *Its* Space Sciences Lab. Ser. 10, Issue 35

(NAS9-7889)

(NASA-CR-114904) Avail: NTIS CSCL 03B

Studies in organic geochemistry are discussed which deal with the isolation and identification of individual organic compounds from various types of terrestrial and extra-terrestrial samples. Experience with a meteorite which fell near Pueblito de Allende, Chihuahua, Mexico provided a model sample in preparing for the analysis of the returned lunar samples. Closely associated with the geochemistry program are investigations into the fundamental nature of fragmentation processes occurring in the ion source in a mass spectrometer was investigated including both electron impact and field ionization phenomena. The development of a computer-coupled low resolution mass spectrometer system for the lunar receiving laboratory is described. This system will perform in the preliminary analysis of the returned lunar sample. A detailed report on the exhaust gas sampling from the lunar module descent engine is also given. Author

N71-19787*# Geological Survey, Menlo Park, Calif.

LUNAR SAMPLE ANALYSIS PROGRAM. MAGNETIC PROPERTIES OF APOLLO 12 LUNAR SAMPLES 12052 AND 12065 Final Report

C. Sherman Gromme 30 Jan. 1971 22 p refs

(NASA Order T-75411)

(NASA-CR-114891) Avail: NTIS CSCL 03B

Magnetization versus field and magnetization versus temperature data indicate that the ferromagnetic material in Apollo 12 samples 1205 and 12065 is spheroidal grains of iron having Curie temperatures of 752 and 788 C respectively. The samples carry natural remanent magnetization (NRM) that is table with respect to the earth's field, of the order of 6 to 20 x 10 to the minus 6th power emu/ gm in intensity. This magnetization consists of several components, all of which are destroyed by heating in

vacuum to temperatures below 600 C. The ability of the rocks to acquire thermoremanent magnetization below 200 C is also destroyed by heating to 600 C. The NRM in these rocks is concluded to have resulted from several magnetizing events that occurred at moderate temperatures some time later than the rocks' last cooling. Author

N71-19913*# Bureau of Mines, Morgantown, W. Va.
INFRARED VIBRATIONAL SPECTROSCOPIC STUDIES OF MINERALS FROM APOLLO 11 AND 12 LUNAR SAMPLES Final Report
Clarence Kara, Jr., Patricia A. Ester, and John J. Kovach [1970] 48 p refs
(NASA Order T-88614)
(NASA-CR-114890) Avail: NTIS CSCL 03B

Infrared vibrational spectral correlations, derived from terrestrial and synthetic minerals, were used to characterize structures of the predominant lunar silicate minerals isolated from crystalline rocks and dusts. Absorption bands in the low-frequency region were used to determine specific compositions for isolated pyroxene, plagioclase, and olivine. For each of these predominant minerals, spectral similarities for separates from both rocks and dusts were observed. Further correlations from the fundamental vibrations of silicate (SiO_4) tetrahedra were used to determine basic compositions for bulk samples from the dusts. The distinctive lunar basaltic spectra, predominant in pyroxene, matched better with some ocean tholeiitic basalts than with tektites, meteorites, or any other terrestrial rock type, but in no case was a good composition obtained. Author

N71-19960*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 3: FLIGHT OPERATIONS AND NETWORK Final Report
May 1970 331 p
(NASA-TM-X-66933) Avail: NTIS HC $6.00/MF $0.95

A mission operations report for the Apollo 13 flight is presented. The report describes the situations, the various alternatives available, the decisions made, and the reasons for the decisions. All data is prepared in real time even in those cases where post mission data shows the real time data to be in error. In addition to the flight director's report, reports are included from the following: (1) booster systems engineer, (2) retrofire officer, (3) flight dynamics officer, (4) guidance officer, (5) procedures officer, and (6) flight activities officer. Author

N71-19962*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 3: FLIGHT OPERATIONS AND NETWORK, ADDENDUM 1 Final Report
Jun. 1970 97 p
(NASA-TM-X-66935; Rept-70-FC13-47-Add-1)
Avail: NTIS CSCL 22A

Apollo 13 lunar module data tabulated post-mission by the TELMU and CONTROL flight controllers is presented. This data is inserted into the Apollo 13 mission operations report in order to complete the operational history of Apollo 13. Author

N71-19970*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APPOLLO 13 INVESTIGATION TEAM. PANEL 2: FLIGHT CREW OBSERVATION Final Report
27 May 1970 4 p
(NASA-TM-X-66923) Avail: NTIS CSCL 22A

A summary of flight crew observations and energency actions taken following explosion of the oxygen tank on the Apollo 13 flight is presented. The effect of the explosion on various spacecraft systems is described. Procedures for lunar module powerup to provide emergency life sustaining capability are discussed. Author

N71-20020*# National Aeronautics and Space Administration, Washington, D.C.
TWENTY-SECOND SEMIANNUAL REPORT TO CONGRESS, 1 JULY–31 DECEMBER 1969
G. R. De Gennaro, H. H. Milton, and W. E. Boardman, eds. 2 Oct. 1970 239 p refs
(NASA-TM-X-66954) Avail: SOD $1.25; NTIS CSCL 22C

The activities and accomplishments of NASA for this period are reported. Topics discussed include: manned space flight, Apollo Program Scientific investigation in space, space applications, and the nuclear rocket developments. F.O.S.

N71-20077*# Cornell Univ., Ithaca, N.Y. Center for Radiophysics and Space Research.
EVOLUTION OF MARE SURFACE
T. Gold Jan. 1971 9 p refs
(Contract NAS9-8018)
(NASA-CR-114892) Avail: NTIS CSCL 03B

Photographic and seismic data against bedrock lying near the lunar surface are discussed, along with the continuing process of surface transportation of lunar rocks. Imbedding of stones and core tube layers is examined, showing soil deposition as a faster process than meteorite plowing over. The compositional differences between soil and rock in the same region are also studied. J.A.M.

N71-20174*# Indiana Univ., Bloomington.
PROPOSAL TITLE: SEARCH FOR C15 TO C30 ALKANES IN LUNAR SOILS Final Report
W. G. Meinschein, Eugene Cordes, and V. J. Shiner, Jr. 22 Feb. 1971 9 p refs
(Contract NAS9-9974)
(NASA-CR-114919) Avail: NTIS CSCL 03B

Benzene-methanol extracts of lunar fine samples 10086 (50g), 12001.31 (11g), 12001.32 (9g), and 12033.6 (5g) were separately obtained on the intact, pulverized, and hydrofluoric acid digested samples. These extracts did not contain detectable quantities of C15 to C30 alkanes exceeding 1 part per billion by weight. Author

N71-20216# Grumman Aerospace Corp., Bethpage, N.Y.
FRICTION BETWEEN SOLIDS AND SIMULATED LUNAR SOILS IN ULTRAHIGH VACUUM AND ITS SIGNIFICANCE FOR THE DESIGN OF LUNAR ROVING VEHICLES
Leslie L. Karafiath *In* NBS Space Simulation Oct. 1970 p 225–244 refs (See N71-20201 09-11)
Avail: SOD $5.25

The initial and kinetic frictions between various solids and ground basalt, simulating the lunar soil, were measured in ultrahigh vacuum with a rotating disk-type apparatus designed for the purpose. Pressures below $p = 10$ to the minus 9th power torr have been routinely reached with the vacuum system consisting of a turbomolecular, a getter-ion and a liquid N2 cooled titanium sublimation pump. The testing program included tests with steel, titanium, and fiber-glass disks and ground basalt in two particle size ranges, coarse (250-500 micron) and fine (38-62 micron). The experimental results show that both the initial and kinetic frictions invariably increase in ultrahigh vacuum. Author

N71-20276*# TRW Systems Group, Redondo Beach, Calif.
STAGE SIZING DATA FOR AN UNMANNED PLANETARY SAMPLE RETURN MISSION, TASK E-94 Project Technical Report
R. D. Gilbertson 5 Feb. 1971 56 p
(Contract NAS9-8166)
(NASA-CR-114918; TRW-17618-H100-R0-00) Avail: NTIS CSCL 22A

Data were generated which can be used to determine outbound and inbound stage weight requirements for specified values of planetary sample return mission payload and energy requirements. The data were calculated by implementing an iterative technique. Plots of the outbound stage weight versus inbound stage weight for 42 combinations of outbound and inbound payload requirements are presented. Author

N71-20277*# McDonnell-Douglas Co., Huntington Beach, Calif.
MICROCHEMICAL, MICROPHYSICAL AND ADHESIVE PROPERTIES OF APOLLO 11 AND 12 Final Report, 1 Aug. 1969 – 15 Mar. 1971
J. J. Grossman, J. A. Ryan, N. R. Mukherjee, and M. W. Wegner 15 Mar. 1971 33 p refs
(Contract NAS9-8082)
(NASA-CR-114916) Avail: NTIS CSCL 03B

Disruption of lunar fines were observed after exposure to O2 and N2O but not to N2. Vacuum formed rock surfaces may be completely inert to dry N2 since even mosaic electrostatic charging (scale <100pM) persists as pressure is raised to one atmosphere. Both air and UV exposure discharge the surface. Chemical etching revealed twinning, plastic and shock deformation in some samples, adhesion due to impact melting in others, dislocations and cosmic ray tracks. The unusual electrostatic adhesion processes of lunar material are tentatively attributed to the absence of a lunar atmosphere. Author

N71-20278*# Chicago Univ., Ill. Dept. of Geophysical Sciences.
DATA ON APOLLO 11 AND 12 SAMPLES. SPECULATIONS ON PETROLOGIC DIFFERENTIATION Final Report
J. V. Smith, A. T. Anderson, Jr., and R. C. Newton 1970 160 p refs
(Contract NAS9-8086)
(NASA-CR-114917) Avail: NTIS CSCL 03B

Apollo 12 rocks consist of rare, light- and predominant dark-colored varieties. The dark rocks are pieces of mare lavas resulting from crystal cumulation and magma mixing, processes known to take place in regions of active volcanism on earth. The light fragments are complex resulting from combination of initial melting, chemical fractionation, fragmentation, remelting and recrystallization. The majority of the light fragments are gray and mottled, and are similar in composition but not identical to some basaltic meteorites and to the Surveyor 7 analyses of highland material. Detailed study of minor elements in olivines and plagioclases of both Apollo 11 and 12 samples permitted distinction of several populations: in particular, high- and low-Cr olivines, high- and low-Ca olivines; and high- and low-Fe plagioclases. Studies of Apollo 12 rocks support proposals that highland and mare rocks crystallized and differentiated from a ultrabasic melt on a planetary scale modified by idiosyncratic local factors. Author

N71-20312# Belgian Royal Observatory, Uccle.
CALCULATIONS OF STAR DECLINATIONS AND PROPER MOVEMENTS FOR THE INTERNATIONAL LATITUDE SERVICE FROM THE MERIDIONAL CATALOGS [CALCUL DES DECLINAISONS ET MOUVEMENTS PROPRES DES ETOILES DU SERVICE INTERNATIONAL DES LATITUDES A PARTIR DES CATALOGUES MERIDIENS]
P. Melchior and R. Dejaiffe 1969 339 p refs In FRENCH
Avail: NTIS HC $6.00/MF $0.95

The original star positions obtained by the Latitudinal Service Bureau before 1936 are updated by calculations of declination and proper motion for all stars not yet included in the basic FK sub 4 system. Utilized are the meridional positions values from 11,501 daily star positions contained in various catalogs. All positions are based on the FK sub 4 system; a least square solution is obtained for each star. The developed catalog contains the star numbers, declination values, proper motion values, specific weights, and the error probabilities. Transl. by G.G.

N71-20318*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OBSERVATIONS OF O AND Of STARS
Sara R. Heap Feb. 1971 37 p refs Submitted for publication
(NASA-TM-X-65465; X-671-71-88) Avail: NTIS CSCL 03A

Spectrograms with a dispersion of 16.2 Angstroms per millimeter covering the spectral range Lambda 3300 to Lambda 4900 were obtained for three early O stars and three early Of stars. Detailed line profiles of selected hydrogen and helium lines were obtained, and equivalent widths of nearly all visible lines were measured. Comparison of the spectroscopic properties between Of stars and O stars suggest that Of stars have lower surface gravities than do O stars. Comparison of their photometric properties confirms this suggestion. Hence, present temperatures scales for O5-O8 stars may possibly be in error because they do not take into account the effect of gravity in determining spectral type. In addition, the spectra suggest that atmospheric models of Of stars should take into account spherical and hydrodynamic effects. Author

N71-20319*# Scripta Technica, Inc., Washington, D.C.
CONTENT OF ALUMINA AND TITANIUM DIOXIDE IN STONE METEORITES [SODERZHANIYE GLINOZEMA I DVUOKISI TITANA V KAMENNYKH METEORITAKH]
M. I. Dyakonova NASA Mar. 1971 5 p refs Transl. into ENGLISH from Meteoritika (Moscow), no. 29, 1969 p 101-103
(Contract NASw-2036)
(NASA-TT-F-13541) Avail: NTIS CSCL 03B

Methods for determining the aluminum oxide and titanium oxide content of stony meteorites are presented. Aluminum oxide content is determined by indirect calculation of the difference from the sum of sesquioxides. Titanium oxide content is determined colorimetrically with hydrogen peroxide. Tables of data are included which show the results obtained by various investigators. Author

N71-20320*# National Aeronautics and Space Administration. Goddard Research Center, Cleveland, Ohio.
EFFECT OF LOW THRUST AND EARTH OBLATENESS ORBIT PERTURBATIONS ON THE DETERMINATION OF THE LAUNCH WINDOW FOR THE SERT 2 MISSION
James E. Cake and John D. Regetz, Jr. Washington Mar. 1971 18 p refs (NASA-TM-X-2233; E-6003) Avail: NTIS CSCL 22A

The SERT II (Space Electric Rocket Test) mission objective is to provide a long-term evaluation of the performance and reliability of an ion thruster system in the space environment. A reivew of the procedures employed to determine the launch window for the SERT II mission is presented. Background is given relating to the Earth-oblateness, Sun-synchronous technique for achieving the continuous sunlight necessary to provide solar electric power to the thruster system. The equations used to mathematically model the oblateness perturbations and low-thrust continuous orbit altitude changing are stated. Included in the selection of the launch time is the Sun interference problem associated with the guidance system of the launch vehicle. Author

N71-20321*# National Aeronautics and Space Administration. Washington, D.C.
EUROPE AND POST APOLLO: THOUGHTS ON THE SPACE HEARING [EUROPA UND POST APOLLO. GEDANKEN ZUM RAUMFAHRT-HEARING]
Mar. 1971 10 p Transl. into ENGLISH from Weltraumfahrt Raketentechnik (West Germany), v. 22, no. 1, Jan.-Feb. 1971 p 3-4
(NASA-TT-F-13547) Avail: NTIS CSCL 22A

The present situation of European space efforts and the problem of European and American cooperation concerning the Post-Apollo program discussions conducted by the German Bundestag Committee on Education and Science are presented. The intention of the conference was to furnish theoreticians and practical

workers from science, research, and industry an opportunity to convey their wishes and ideas on future space programs to responsible persons in government. Author

N71-20322*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
LOST CITY METEORITE: IT'S RECOVERY AND A COMPARISON WITH OTHER FIREBALLS
R. E. McCrosky, A. Posen, G. Schwartz, and C.-Y. Shao Oct. 1970 43 p refs Revised
(Grant NGR-09-015-004)
(NASA-CR-117036; SAO-010-02A) Avail: NTIS CSCL 03C

The Lost City meteorite was photographed in flight and recovered by the Prairie Network. Four fragments totaling 17 kg have been found. Photometric and trajectory data for the Lost City meteor and for a subsequent meteor (No. 40617) with similar flight characteristics are used to establish a preliminary calibration of the mass scale of other fireballs. There is excellent agreement between the photometric masses derived from the most recent determination of the luminous efficiency of the meteoric process, and the dynamic masses determined from the trajectory and the shape of the recovered meteorite. It is unlikely that photometric masses are overestimated by as much as a factor of 8 for objects of the size and composition of Lost City. Previous values for meteoroid bulk densities may have been seriously underestimated (by a factor of 5 or 8) if the flattened shape observed for Lost City and inferred from 40617 is common among meteoroids. Author

N71-20323 Connecticut Univ., Storrs.
DIFFERENTIAL APPROXIMATION AND QUASILINEARIZATION FOR THE DETERMINATION OF POWERED AND UNPOWERED ORBITS
Gilbert Charles Carpenter, Jr. (Ph.D. Thesis) 1969 154 p
Avail: Univ. Microfilms: HC $7.20/Microfilm $3.00 Order No. 70-1246

Improvements in the methods used to determine the orbits of coasting vehicles and a fundamental approach to estimating the time history of the position, velocity and thrust program for a powered vehicle are presented. Orbit determination is a multi-point boundary value problem subject to a set of nonlinear differential equations which can be solved by the method of quasilinearization. When this numerical method is applied formally to the determination of coasting orbits the method suffers from extensive computer storage requirements, fairly long execution times, and in some cases insufficient accuracy. To remove these practical difficulties modifications to the computational algorithm are presented which eliminate solution storage for the most part and improve its computational speed and its tolerance to inaccurate integration algorithms. Dissert. Abstr.

N71-20324*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECT OF SOUTH ATLANTIC MAGNETIC ANOMALY ON SERT 2 ORBITAL ACCELERATION MEASUREMENTS
Daniel J. Lesco and William C. Nieberding Washington Mar. 1971 8 p refs
(NASA-TM-X-2232; E-6029) Avail: NTIS CSCL 08N

Unpredicted perturbations as large as 0.1 micro g in the measured SERT 2 spacecraft orbital acceleration are described and correlated with the South Atlantic magnetic anomaly. Acceleration measurements were obtained both before and after the ion-thruster turnon. The accelerometer data showed a marked perturbation whenever the spacecraft in its 1000 kilometer orbit passed over the South Atlantic in the region of known magnetic anomaly. Author

N71-20327*# Techtran Corp., Glen Burnie, Md.
REPORT ON THE TEXTURE OF LUNAR SAMPLES 12018.43 AND 12063.53
P. Leymarie et al Washington NASA Mar. 1971 11 p Transl. into ENGLISH of Center de Rech. Petrog. et Geochim., Vandoeuvre, France, report p 1–11
(Contract NASw-2037)
(NASA-TT-F-13561) Avail: NTIS CSCL 03B

The crystalline orientation in lunar samples is discussed. Subjects presented are: (1) selection of samples suitable for study with a texture goniometer, (2) difficulties encountered in sectioning and shaping the samples, (3) examples of particularly clear crystal orientations, and (4) proposal for a complementary study. Author

N71-20328# California Univ., Los Angeles. School of Engineering and Applied Science.
THE CONJUGATE GRADIENT METHOD AND ITS APPLICATION TO AEROSPACE VEHICLE GUIDANCE AND CONTROL. PART 2: MARS ENTRY GUIDANCE AND CONTROL
Cornelius T. Leondes and C. A. Wu (Wyoming Univ.) Nov. 1970 34 p refs
(Grant AF-AFOSR-0699-67)
(AD-716576; AFOSR-70-2781TR) Avail: NTIS CSCL 12/1

The conjugate gradient method is shown to be an effective method for the guidance and control of aerospace vehicles. Mars reentry is considered as an example. As the entry angle and entry velocity are not known exactly beforehand and as there is a difference between the density of the Martian atmosphere and the assumed density profile during aerodynamic braking, an adaptive lambda matrix control element must be utilized. It is noted that the nominal trajectory on which the adaptive scheme is based does not need to be optimum in any sense. It can be any trajectory that satisfies desired boundary conditions. Author (GRA)

N71-20389# Universidad Mayor de San Andres, La Paz (Bolivia). Laboratorio de Fisica Cosmica.
BOLIVIAN REPORT ON THE TOTAL SOLAR ECLIPSE, 12 NOVEMBER 1966
[1968] 33 p refs Presented at the Eclipse Symp., Sao Paulo, Brazil, 1968
Avail: NTIS

A description of the meteorological prevailing conditions at different places along the eclipse totality path inside Bolivia, and other scientific and technical considerations that were analyzed and used in the selection of the observation sites are presented. Proposed programs of observations, type of instruments used and scientific and technical personnel involved in the expeditions; results obtained and type of cooperation provided to the expeditions by different Bolivian institutions are discussed. The Eclipse experiments conducted at different Bolivian sites, included sky brightness and color measurements, corona and chromosphere observations, ionospheric soundings at low and high frequencies and ozone density measurements. Author

N71-20460*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1969 PROJECT REPORT. VOLUME 2: PERFORMANCE Final Report
L. A. Adams, W. N. Apel, C. M. Ashley, J. Ball, D. L. Brunn et al 1 Mar. 1971 317 p refs
(Contract NAS7-100)
(NASA-CR-117351; JPL-TR-32-1460-Vol-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 22A

The dual-spacecraft (Mariners 6 and 7) Mars flyby mission was successfully conducted according to plan. A number of flight anomalies were observed, including a major incident involving the Mariner 7 spacecraft shortly before its Mars encounter, but these difficulties were overcome. The performance of all elements was generally excellent, and copious scientific data were returned to the Earth, including television pictures, ultraviolet and infrared spectral data, surface-temperature measurements, and other information.

The flight performance of each element is analyzed, problems are discussed, and recommendations based on the experience are presented. Author

N71-20479*# Bionetics Corp., Hampton, Va.
ANALYSES AND SENSITIVITY STUDIES RELATED TO POST LAUNCH RECONTAMINATION OF SPACECRAFT AND THE PROBABILITY OF CONTAMINATION OF A PLANET Final Report
30 Dec. 1970 66 p refs Prepared for JPL
(Contracts NAS7-100; JPL-953009)
(NASA-CR-117386) Avail: NTIS CSCL 22A

Analyses of the probability of post-launch recontamination of spacecraft and the subsequent probability of planetary contamination were performed for fly-by, orbiter and lander capsule unmanned planetary missions. Sources of microbial contamination, pertinent mission events and spacecraft design and operating characteristics were identified and analyzed. The recontamination of the spacecraft from the shroud during the launch phase was identified as a problem common to all types of missions. The additional factor of redistribution of organisms from the non-sterile portions of the spacecraft to the attached lander capsule prior to capsule de-orbit was also studied. Studies were made of the sensitivity of the probability of planetary contamination to the various factors involved in recontamination for the three types of missions. Of the various factors, the probability of particle ejection from spacecraft surfaces was found to be of greatest significance for all missions. Author

N71-20480*# National Aeronautics and Space Administration, Washington, D.C.
EXPERIMENT PROGRAM FOR EXTENDED EARTH ORBITAL MISSIONS. VOLUME 1: SCIENCE AND APPLICATIONS
1 Sep. 1969 521 p refs Revised
(NASA-TM-X-66906) Avail: NTIS HC $6.00/MF $0.95 CSCL 22A

An experiments payloads plan for the space station of the mid-seventies is presented. Three experiments program options have been developed. Each option was generated to accommodate varying levels of experiment accomplishments and assumed different levels of funding availability. The experiment program plan was developed to provide maximum flexibility from the standpoint of operations and funding. It allows selection of individual experiment packages or modules to accomplish a specific entity of the overall experiment program. Author

N71-20481* National Aeronautics and Space Administration, Washington, D.C.
PROJECT: IMP-1
10 Mar. 1971 25 p *Its* Release No. 71-35
Avail: NASA Scientific and Technical Information Facility, P. O. Box 33, College Park, Md. 20740 CSCL 22A

The design and operation of the IMP-1 satellite and the space experiments to be conducted following launch and orbit are discussed. Scientific objectives of the mission are: (1) energetic particles and cosmic ray detection, (2) solar plasma experiment, (3) magnetic and electric field investigation, (4) radio astronomy investigation, (5) computer engineering experiment, and (6) study of low frequency radio waves from the Earth's magnetosphere. Author

N71-20495*# Chrysler Corp., New Orleans, La. Engineering Dept.
GRAVITY SUBSTITUTE WORKBENCH (SKYLAB EXPERIMENT-M507) Final Report
P. E. Theobald Jan. 1971 274 p refs
(Contract NAS8-21385)
(NASA-CR-117044; TR-EE-70-43) Avail: NTIS CSCL 22A

The development and design of a gravity substitute workbench using both electrostatic and aerodynamic principles are presented with the fabrication and testing of flight configurations of the electrostatic workbench for use in the skylab program. Although all aspects of safety (such as ozone, X-ray, and ultra-violet) were not proven, it was demonstrated that injurious electrical shock could not be experienced in using this equipment. However, the operator should be furnished with a suitable grounding strap to preclude experiencing an occasional mild shock that can occur under certain conditions. The design was proven by functional and environmental testing to be satisfactory. Some erratic results, however, were noted in the electroadhesive forces obtained. Further study, development, and testing is recommended to achieve optimum and consistent results. Author

N71-20502*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
APPROXIMATE TRAJECTORY DATA FOR MISSIONS TO THE MAJOR PLANETS
Laurence H. Fishbach, Lawrence L. Givanter, and Edward A. Willis Jr. Washington Mar. 1971 215 p refs
(NASA-TN-D-6141; E-5892) Avail: NTIS CSCL 22A

Impulsive velocity increment (Delta V) requirements for one-way trajectories from low-Earth orbit to the major planets are presented in the form of contour charts and tables. The given Earth-to-planet data also apply to return transfers, thereby permitting round trips to be analyzed. The charts relate propulsive effort to departure and arrival dates, travel times, and planetary configurations; they are designed for rapid identification of efficient mission trajectories. The tabular presentation includes hyperbolic speeds and a summary of orbit elements and geometry. These basic data are applied to several major-planet missions. The sample trajectories illustrate the applicability of the data and the methods of using them. For one-way flyby missions it was found that near minimum Delta V's in the 8 kilometer per second range are required for travel times ranging from 1.1 years (to Jupiter) to 16 years (to Neptune). An additional Delta V of about 1 kilometer per second in most cases is sufficient to bring the vehicle into a highly elliptical parking orbit (compared to 7 to 22 km/sec Delta V to enter a low circular parking orbit). For each planet, a family of symmetric nonstop round-trip trajectories based on a nonpropulsive gravity turn maneuver was constructed. The minimum Delta V's were again in the 8 kilometer per second range; however, these missions required 2.5 to 30 year trip times. Author

N71-20513*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 9 FLIGHT PLAN AS-504/CSM-104/LM-3 Final Report
J. V. Rivers 3 Feb. 1969 348 p refs
(NASA-TM-X-66904) Avail: NTIS CSCL 22A

Schedules for the AS504/CSM104/LM3 operational and crew activities to fulfill, when possible, the test objectives defined in the mission requirements, D mission, LM evaluation and combined operations are reported. The trajectory parameters used in this flight plan are for a February 20, 1969 launch, with a 72 deg launch azimuth as defined by the Apollo Mission D spacecraft operational trajectory. Author

N71-20538*# Scientific Translation Service, Santa Barbara, Calif.
EXTRA HIGH RESOLUTION RADIOINTERFEROMETRY [RADIOINTERFEROMETRIYA SO SVERKHVYSOKIM RAZRESHENIYEM]
L. I. Matveyenko Washington NASA Mar. 1971 7 p ref Transl. into ENGLISH from Priroda (Moscow), no. 8, Aug. 1970 p 66–68
(Contract NASw-2035)
(NASA-TT-F-13519) Avail: NTIS CSCL 03A

A discussion of recent radiotelescope interferometer experiments between stations in the United States and the U.S.S.R. is given. Telescopes at Greenbank, Virginia and the Crimean Astrophysical Observatory were used to observe the details of several galaxies. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N71-19639*# Hughes Aircraft Co., Culver City, Calif.
MISSION ANALYSIS AND METHODOLOGY, PART 1
In its Parametric Analysis of Microwave and Laser Systems for Commun. and Tracking, Vol. 2 Feb. 1971 86 p (See N71-19638 09-08)
Avail: NTIS CSCL 22A

The methodology for design of space communication systems based on the type of space mission, the data requirements, and the time duration is discussed. Once a particular mission is selected, several design constraints are imposed upon the communication system. Constraints discussed are: (1) data rate, (2) acquisition and tracking, (3) communication range, (4) mission duration, and (5) communication weight restrictions. The methodology designs the least expensive or lightest communications system within the constraints of the range equation. Computer results of the methodology are given which compare laser and microwave systems for a Mars mission. Author

N71-19953*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 6: RELATED SYSTEMS EVALUATION. VOLUME 2: SUMMARY Final Report
27 May 1970 29 p
(NASA-TM-X-66928) Avail: NTIS CSCL 22B

A reevaluation of Apollo spacecraft system design based on the failure of the command service module cryogenic oxygen tank which caused the Apollo 13 incident is presented. The Apollo 13 incident was apparently an electrically induced failure in an oxygen tank. For this reason emphasis was placed on the design criteria of oxygen and oxidizer systems and electrically induced modes of failure. Author

N71-19954*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 1: SPACECRAFT INCIDENT INVESTIGATION. VOLUME 1: ANOMALY INVESTIGATION Final Report
10 Jun. 1970 104 p
(NASA-TM-X-66922) Avail: NTIS CSCL 22B

There were two investigative aspects associated with the loss of the cryogenic oxygen tank pressure during the Apollo 13 flight. First, what was the cause of the flight failure of cryogenic oxygen tank 2. Second, what possible contributing factors during the ground history of the tank could have led to the ultimate failure in flight. The first flight indication of a problem occurred when the quantity measurement in the tank went full scale about 9 hours before the incident. This condition in itself could not have contributed to ignition in the tank, since the energy in the circuit is restricted to about 7 millijoules. Data from the electrical system provided the second indication of a problem when the fans in tank 2 were activated to reduce any stratification which might have been present in the supercritical oxygen in the tank. Several short-circuits were detected and have been isolated to the fan circuits of tank 2. The first short-circuit could have contained as much as 160 joules of energy, which is within the current-protection level of the fan circuits. Tests have shown that two orders of magnitude less energy than this is sufficient to ignite the polytetrafluorethylene insulation on the fan circuits in the tank. Consequently, the evidence indicates that the insulation on the fan wiring was ignited by the energy in the short-circuit. Author

N71-19955*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 1: SPACECRAFT INCIDENT INVESTIGATION. VOLUME 3: REPORTS OF ANALYSES AND TESTS PERFORMED IN SUPPORT OF THE CRYOGENIC OXYGEN TANK 2 ANOMALY INVESTIGATION
Sep. 1970 412 p refs
(NASA-TM-X-66934) Avail: NTIS CSCL 22B

A thermodynamic analysis to describe the stratification phenomenon occuring in the oxygen tank of the Apollo 13 command service module was conducted. A summary of the various analysis tasks performed during the course of the investigation in areas related to thermodynakics, heat transfer, and fluid flow is presented. The various tests performed during the course of the investigation are described. Author

N71-19956*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 8: HIGH PRESSURE OXYGEN SYSTEMS SURVEY, ADDENDUM 1 Final Report
5 Jun. 1970 11 p refs
(NASA-TM-X-66926) Avail: NTIS CSCL 22B

A review of current test methods to determine the fire or explosion hazards of materials exposed to liquid or gaseous oxygen is presented. The types of materials are those that might react to an external stimulus and not those that tend to react with oxygen during static exposure, since such materials would not be used in spacecraft structures. The types of ignition stimuli include sparks, electrical short circuits, friction, mechanical impact, hydrodynamic shock, pneumatic shock, and bulk heating. Once ignition occurs, propagation rates to determine if the material will self quench, burn rapidly, burn slowly, or explode are important. Author

N71-19958*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 5B: CORRECTIVE ACTION STUDY AND IMPLEMENTATION FOR LUNAR MODULE Final Report
28 May 1970 5 p
(NASA-TM-X-66929) Avail: NTIS CSCL 22B

An investigation of the need for corrective action and proposed hardware implementation for the lunar module following the Apollo 13 flight incident was conducted. There were no recommendations for lunar module hardware changes. Lunar module items requiring additional investigation (1) descent stage propellant quantity gaging system, (2) ascent stage propellant low level detector, (3) loss of thermal shields, (4) batteries, (5) pressure transducers, and (6) temperature sensors. Author

N71-19959*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 5C: CORRECTIVE ACTION STUDY AND IMPLEMENTATION FOR GOVERNMENT FURNISHED EQUIPMENT Final Report

8 May 1970 80 p
(NASA-TM-X-66930) Avail: NTIS CSCL 22B

A description of the investigation of the government furnished equipment used during the Apollo 13 flight is presented. The results of various studies undertaken, and the significant conclusions and recommendations are described. Systems discussed are: (1) life support systems, (2) pressure vessels, and (3) contingency equipment use. A review of the criticality ratings of government furnished equipment is provided. Author

N71-19961*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 9: SAFETY, RELIABILITY AND QUALITY ASSURANCE Final Report
May 1970 12 p refs
(NASA-TM-X-66924) Avail: NTIS CSCL 22B

The Safety/R&QA Panel 9 to the MSC Apollo 13 Investigation Team was established to provide the following functions:(1) act in an advisory capacity to the team manager, (2) provide specific documentation and documentation control, and (3) provide technical support to other panels and members of the investigation board. The activities and Safety/R&QA (Panel 9) recommendations are presented. Author

N71-19963*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 6: RELATED SYSTEMS EVALUATION. VOLUME 3: COMMAND AND SERVICE MODULE Final Report
May 1970 248 p
(NASA-TM-X-66918) Avail: NTIS CSCL 22B

The results of an investigation conducted by Panel 6 of the Apollo 13 flight investigation team are presented. The results of an evaluation of systems other than the cryo 02 tank portion of the EPS which might possess the potential for the same general class of failures are discussed. Systems investigated were: (1) environmental control, (2) electrical power, (3) reaction control of command module, (4) reaction control of service module, and (5) service propulsion. Author

N71-19964*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 8: HIGH PRESSURE OXYGEN SYSTEMS SURVEYS Final Report
15 May 1970 134 p refs
(NASA-TM-X-66925) Avail: NTIS CSCL 22B

As a part of the MSC Apollo 13 Investigation Team, Panel 8 was formed to conduct a survey of the state of the art of breathing oxygen systems design. Typical commercial aviation, military aviation, submarine, aircraft carrier, hospital, and altitude chamber oxygen systems, and the Gemini cryogenic system were reviewed in depth by the panel, and technologies, standards, and criteria were examined for similarities and differences. The panel found no great technological differences or unique problem areas, however, there was considerable common concern for better and improved material selection and testing methods, safety criteria, and means of adapting or controlling electrical interfaces. Author

N71-19965*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 8A: CORRECTIVE ACTION STUDY AND IMPLEMENTATION FOR COMMAND AND SERVICE MODULES (CSM)
12 Jun. 1970 78 p
(NASA-TM-X-66932) Avail: NTIS CSCL 22B

The results of a study on command service module configuration and recommendations to prevent Apollo 13 flight type emergencies are presented. The three areas discussed are: (1) study and implementation of corrective action associated with the cryogenic oxygen system failure which occurred on Apollo 13, (2) establishment of the as-flown configuration of the command service module and identification of differences with other command service modules, and (3) assessment of the feasibility and implementation of corrective action for potential problems. Author

N71-19966*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 7: REACTION PROCESSES IN HIGH PRESSURE FLUID SYSTEMS Final Report
28 May 1970 245 p refs
(NASA-TM-X-66919) Avail: NTIS CSCL 22B

The results of the physical, metallurgical, chemical, and thermodynamic surveys that have been made on the high pressure tank and plumbing systems of the Apollo spacecraft are presented. These systems comprise the pressurized oxygen, hydrogen, nitrogen, propellant, and helium tanks and related plumbing of the command, service, and lunar modules. The purposes of the surveys are to lend support to the Apollo 13 investigation, to provide review and to extend knowledge of spacecraft pressure systems, and to contribute to the safety of future manned space flights. To achieve these objectives, descriptive data for all tanks were collected, a metallurgical survey and a comprehensive physical chemical survey of all systems were made, and some detailed thermodynamical calculations were performed. Author

N71-19968*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 6: RELATED SYSTEMS EVALUATION. VOLUME 2: LUNAR MODULE Final Report
May 1970 259 p Prepared by Grumman Aerospace Corp.
(NASA-TM-X-66927) Avail: NTIS CSCL 22B

A study of Lunar Module (LM) related systems has been conducted in support of the Apollo-13 investigations. The results of that study are summarized. Information is presented on the following subsystem elements for both the descent and ascent stages: (1) propulsion and reaction control propellant and pressurant tanks, (2) oxygen tanks, (3) water tanks, and (4) batteries. Author

N71-19969*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
MSC APOLLO 13 INVESTIGATION TEAM. PANEL 1: SPACECRAFT INCIDENT INVESTIGATION. VOLUME 2: MANUFACTURING AND TEST HISTORY OF OXYGEN TANK Final Report
Jul. 1970 74 p
(NASA-TM-X-66921) Avail: NTIS CSCL 22A

A detailed review was made of tank fabrication of oxygen tank 2 used on Apollo 13 flight. Assembly and test records, material review dispositions, and failure reports were reviewed. Due to the particular significance of the fan, heater, and density probe wiring, a special review and demonstration of assembly methods of these components was made. The installation procedures for heater, fan, and probe wiring were found to be critical, with several areas where routing damage would not be visible on the assembled product. Assembly records for this tank revealed no significant data except for a prevalence of fan motor wiring problems. These had apparently been corrected by improved procedures and inspection requirements prior to fabrication of the motor installed in tank for delivery. None of the testing or inspections conducted gave any positive indication of actual pre-shipment damage. The tank was accepted with a waiver for an out out-of-specification heat leak rate. This appeared to have no bearing on the flight failure. Author

N71-20272*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
SUMMARY REFURBISHMENT COST STUDY OF THE THERMAL PROTECTION SYSTEM OF A SPACE SHUTTLE VEHICLE
D. W. Haas 1 Mar. 1971 14 p
(Contract NAS1-10093)
(NASA-CR-111833) Avail: NTIS CSCL 22B

A refurbishment cost study of the thermal protection system of a space shuttle is presented. The purpose of the study was to identify labor costs associated with inspection, repair, and replacement of components of representative thermal protection systems (TPS) for space shuttle orbiter application. Those TPS considered included ablative, metallic, and nonablative, nonmetallic heat shields. Author

N71-20350# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LIQUID PROPELLANT ROCKET AS A CONTROLLED OBJECT
K. W. Kolesnikov 23 Oct. 1970 369 p refs Transl. into ENGLISH of the book "Zhidkostnaya Raketa Kak Obekt Regulirovaniya", Moscow, 1969 p 1-299
(AD-716510; FTD-HC-23-461-69) Avail: NTIS CSCL 19/7

The book discusses the differential equations of the perturbed motion of a rocket for three different dynamic models: an ideally rigid body; an elastic inhomogeneous rod; a rigid body with cavities partially filled with liquid. In the study of the dynamic characteristics of the rocket, the oscillations of liquid in tanks were replaced by the oscillations of mathematical pendulums. Results are given of an experimental investigation of the fuel oscillating in tanks. A presentation is made of the methods of determining the modes and frequencies of the natural vibrations of the fuselage. A determination is made of the amplitude-phase frequency characteristics of the rocket, and of those features of the characteristics that are due to the fuel oscillating in tanks and the elastic vibrations of the fuselage. A stability analysis of rocket motion leads to a formulation of additional requirements on the frequency characteristics of the control system and on the location of the gyroscope along the fuselage. Attention is given to certain methods of stabilizing the oscillating motion of fuel in tanks as well as the elastic vibrations of the fuselage. Author (GRA)

N71-20396* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATELLITE DESPIN DEVICE Patent
John J. Milly, inventor (to NASA) Issued 9 Sep. 1969 (Filed 7 Jun. 1967) 8 p Cl. 244-1; Int. Cl. B64g9/00
(NASA-Case-XMF-08523; US-Patent-3,465,986; US-Patent-Appl-SN-645563) Avail: US Patent Office CSCL 22B

A mechanical device for stabilizing and despinning satellites is described. A grasping device comprising an extensible boom connected to a powerhead having several pivotally mounted arms is placed in contact with the satellite. A rotary rocket motor in the powerhead generates thrust which tends to contra-rotate the powerhead and stop rotation of the grasped object. Official Gazette of the U.S. Patent Office

N71-20470*# Grumman Aerospace Corp., Bethpage, N.Y. Product Support Dept.
LUNAR MODULE: LM10 THROUGH LM14
1 Nov. 1969 154 p
(Contract NAS9-1100)
(NASA-CR-117321; LMA790-2) Avail: NTIS CSCL 22A

This manual has been prepared as an aid for orientation and indoctrination purposes only. It describes the LM mission, structure, subsystems, and ground support equipment, including modifications being incorporated into LM's 10 through 14 to support increased lunar mission requirements. Coverage applicable only to the modified vehicle is identified in blue. Subsystem changes related to the modification program are summarized. Author

N71-20471*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SERT 2 SPACECRAFT ELECTRICAL POWER SYSTEM
Richard J. Krawczyk Washington Mar. 1971 22 p
(NASA-TM-X-2234; E-5990) Avail: NTIS CSCL 22B

The SERT 2 spacecraft utilizes a 1.5-kW solar array as the primary source of electrical power. The spacecraft power system controls this power as required for housekeeping functions, experiments, and ion thruster system. To meet mission objectives, three separate systems were designed and implemented - regulated dc power, unregulated dc power, and ac power. Extensive ground command capability allows versatility of configuration for normal as well as abnormal flight conditions. Redundancy, fusing, diode isolation, and automatic switching were employed to minimize possibilities of mission critical component failures. Design objectives have been demonstrated in flight. Author

N71-20473*# National Aeronautics and Space Administration, Washington, D.C.
BUFFETING DURING ATMOSPHERIC ASCENT: SPACE VEHICLE DESIGN CRITERIA (STRUCTURES)
H. A. Cole, A. L. Erickson, and A. G. Rainey Nov. 1970 19 p refs Revised
(NASA-SP-8001) Avail: NTIS CSCL 22B

The occurrence of buffeting during atmospheric ascent depends primarily on the shape of the vehicle; its severity depends on dynamic pressure, Mach number, and angle of attack, as well as shape. Unfavorable shape factors include protuberances, swellings, and abrupt changes in vehicle profile, especially at or near the forward end of the vehicle. A review of buffeting work on aircraft is given. Generally, buffeting is associated with separation of the boundary layer and transition to turbulent flow. A satisfactory solution of the buffeting phenomenon by analytical means has not been found and, at present, experimental results must be used for prediction of buffeting loads. Author

N71-20474*# Georgia Inst. of Tech., Atlanta. Div. of Electronics.
SPACE VEHICLE ELECTRICAL POWER SYSTEMS STUDY Interim Technical Report
S. L. Robinette, G. W. Bechtold, and G. W. Spann 22 Jan. 1971 116 p refs
(Contract NAS8-25192)
(NASA-CR-103072) Avail: NTIS CSCL 22B

Two alternative distribution systems are modeled for a space station: (1) a 110 Vdc system, with conversion of some power to 115 Vac, 400 Hz, and to 28 Vdc; and (2) a 115/200 Vac, 400 Hz system with conversion of some power to 115 Vdc and 28 Vdc. The latter distribution system is recommended for a space station with power supplied by an isotope/Brayton source. A dual 115 Vdc and 115/200 Vac, 400 Hz, 3 farad distribution system is recommended for the orbiter, and a 115/200 Vac, 400 Hz, 3 farad distribution system is recommended for the booster. Author

N71-20475*# TRW Systems, Redondo Beach, Calif.
ENGINEERING MODEL TEST PLAN. SPACE STORABLE PROPELLANT MODULE ENVIRONMENTAL CONTROL TECHNOLOGY
O. O. Haroldsen and R. N. Porter 23 Nov. 1970 32 p
(Contract NAS7-750)
(NASA-CR-117042; TRW-14051-6006-T0-00) Avail: NTIS CSCL 22A

The test plan for the engineering model of the thermal control system design for the space storable propellant module is

outlined. Testing objectives are to verify thermal control system design operation under simulated extreme environmental conditions and to provide a basis for proposed changes. Considered are vibration test, groundhold thermal test, and flight thermal test. G.G.

N71-20483*# Martin Marietta Corp., Denver, Colo.
SPIN VECTOR CONTROL FOR A SPINNING SPACE STATION. VOLUME 2: ANALYTIC MANUAL Final Report
T. Hendricks, W. Guderian, G. Johnson, and G. Haynes Nov. 1970 91 p refs
(Contract NAS8-25247)
(NASA-CR-117310; MCR-70-457-Vol-2) Avail: NTIS CSCL 22B

A technical study for developing an efficient computer program for a restricted rotational dynamics problem involving multiple bodies connected by movable joints is reported. The configuration is particularly applicable to a space station system with a rotor producing a large spin vector. The computer program is an effective tool for studying control and effects of the spin vector on other functions. Author

N71-20484*# North American Rockwell Corp., Downey, Calif. Space Div.
A STUDY OF RESISTOJET SYSTEMS DIRECTED TO THE SPACE STATION/BASE Final Report
L. F. Duncan, G. C. Schaedle, and R. A. Proeschel 31 Dec. 1970 190 p refs
(Contract NAS1-10170)
(NASA-CR-111863) Avail: NTIS CSCL 22B

The planned development and demonstration of a prototype biowaste resistojet subsystem is conducted in a manner so as to be realistic, considering space station/base operation conditions and requirements. The study is based on the characteristics of the solar array powered space station and the space base. Information from the space station phase B study is utilized as it becomes available. Author

N71-20508# TRW Systems, Redondo Beach, Calif.
THE DESIGN AND DEVELOPMENT OF THE MAGNETICALLY CLEAN PIONEER SPACECRAFT
C. A. Eberhard 4 Feb. 1966 70 p refs
(TRW-2515-6004-R0-00) Avail: NTIS

Details of the manner in which magnetic cleanliness was designed into Pioneer spacecraft from the beginning of the program are summarized. The nonmagnetic design was monitored and verified by extensive testing throughout the program, culminating in a final series of spacecraft tests. Results are presented and discussed for tests including the magnetic properties of incoming parts, the engineering model, Pioneer assemblies, and the determination of the cause and magnitude of failures. J.M.

N71-20509*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
A SUMMARY OF MAJOR NASA LAUNCHINGS: 1 OCTOBER 1958 - 30 SEPTEMBER 1970
Dec. 1970 155 p refs Revised
(NASA-TM-X-66958; Rept-1) Avail: NTIS CSCL 22D

The summary includes major NASA launchings conducted under the direction of the John F. Kennedy Space Center (or its antecedents) from both the eastern and western test ranges. The report is divided into projects within broad mission categories, with each project being treated chronologically. Mission results have been categorized as: successful (S); unsuccessful (U); or, partially successful (P). These are arbitrary classifications, made after a comparison of objectives and actual results. Author

N71-20510*# Chrysler Corp., Huntsville, Ala. Space Div.
ADDITIONAL CORRECTION OF 4 PERCENT SATURN 5 PROTUBERANCE TEST DATA
George F. McCanless, Jr. 21 Jan. 1971 39 p refs
(Contract NAS8-30517)
(NASA-CR-103064; HSM-R1-71) Avail: NTIS CSCL 22B

Tests measuring wind tunnel background pressure fluctuations were conducted in a 16 ft transonic wind tunnel. The objective of these tests was to obtain data that can be used to correct Saturn V test data obtained in this facility. Described are the results of the calibration of this wind tunnel and also summarized are the calibrations of numerous other transonic facilities. The frequencies and amplitudes are discussed. The noise sources are identified and methods of reducing the test section noise levels are enumerated. Author

N71-20512*# Brunswick Corp., Lincoln, Nebr. Technical Products Div.
LOW COST FABRICATION METHOD FOR ABLATIVE HEAT SHIELD PANELS FOR SPACE SHUTTLES
Harry T. Abbott [1970] 123 p
(Contract NAS1-9945)
(NASA-CR-111835) Avail: NTIS CSCL 22B

Space shuttles require a reliable, low cost thermal protection system to survive the reentry environment. Replaceable ablative panels, prefabricated for attachment to the external surface of the vehicle, can adequately provide the necessary protection. The development and application of a low-cost compression molding process for this type of ablative panel is described. Flat and curved panels of four different ablative compositions were fabricated. Detailed fabrication procedures, material costs, fabrication hours for all processes, costs of fabricated panels, and estimated costs for various panel sizes, shapes and quantities are presented. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N71-19403# National Aeronautical Establishment, Ottawa (Ontario). Structures and Materials Lab.
DEVELOPMENT OF AN EXPERIMENTAL METHODOLOGY FOR STUDYING MOTOR VEHICLE IMPACTS WITH FLEXIBLE SAFETY BARRIERS
G. L. Basso, H. F. L. Pinkney, and G. F. W. McCaffrey *In* Natl. Res. Council of Canada Div. of Mech. Eng. and the Natl. Aeron. Estab. 30 Sep. 1970 p 1-28 refs (See N71-19401 09-11)
Avail: NTIS

The development of a validated digital computer simulation of an automobile impacting a flexible safety barrier is studied. The program is directed particularly towards the cable configuration. Specifically it was envisaged that experimental capabilities would provide a three-fold purpose: (1) to permit an engineering evaluation of the effect of changes in parameters for a given vehicle - barrier configuration; (2) to provide for initial experimentation when assessing the importance of parameters to be used in analytical studies; and (3) to supply sufficiently controlled experimental conditions for validating computer simulation studies of this class of problem. A description is presented of the development of these facilities as they now exist. Some new and novel methods of experimentation and measurement have been developed; for example a photographic technique, employing a single high speed movie camera, has been developed to obtain the six rigid body motions of the sprung mass of a vehicle. Although to date the test facilities have been used exclusively for validation studies of vehicle - cable barrier impacts, the experimental facilities can be readily adapted to handle a wide variety of problems of the single vehicle impact type. Author

N71-19672# Shock and Vibration Information Center (Defense), Washington, D.C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 2, NUMBER 12, DECEMBER 1970
Roland L. Eshelman, Sharon Cogbill, I. N. Daniel, K. E. McKee, W. D. Pilkey et al. eds. Dec. 1970 79 p refs
(AD-716203) Avail: NTIS CSCL 20/11

Contents: Feature article--plastic models for structural analysis (Part II); Reviews of meetings; News briefs; Short courses; Abstracts from the current literature (Analysis and design methods, Excitation, Phenomenology, Experimentation, Components, and Systems). GRA

N71-19726*# Rensselaer Polytechnic Inst., Troy, N.Y.
MATERIALS RESEARCH Semiannual Progress Report, 1 Mar. 1970–31 Aug. 1970
Sep. 1970 89 p refs
(Grant NGL-33-018-003)
(NASA-CR-117134) Avail: NTIS CSCL 20K

CONTENTS:

1. STRUCTURAL CHARACTERIZATION p 3–24 refs (See N71-19727 09-18)
2. SOLID STATE REACTIONS AND PHASE TRANSFORMATIONS p 25–36 (See N71-19728 09-26)
3. MECHANICAL PROPERTIES AND STRENGTHENING MECHANISMS p 37–55 (See N71-19729 09-32)
4. ELECTRONIC AND PHYSICAL PROPERTIES OF MATERIALS p 56–68 (See N71-19730 09-18)

N71-19729*# Rensselaer Polytechnic Inst., Troy, N.Y.
MECHANICAL PROPERTIES AND STRENGTHENING MECHANISMS
In its Mater. Res. Sep. 1970 p 37–55 (See N71-19726 09-32)
Avail: NTIS CSCL 20K

The research on the behavior of a variety of metal alloys, polymers and composites are reported. The highlights include: (1) Unique observations of effects on crack path in beta brass embrittled in a liquid metal environment. (2) Potential new insights on the fracture of alloyed ferrites from observations on high purity ferrite. (3) Torsion test results on Al-Zn eutectoids which may open a means of characterizing superplasticity. (4) Development of a thermal shock method for studying the role of localized stresses in dispersion strengthening. (5) Observations which specifically associate low shear strengths with surface orientation in the structure of high modulus graphite fibers used in composites. Author

N71-19826# Naval Ship Research and Development Center, Washington, D.C.
ELASTIC STRENGTH OF PROPELLERS: AN ANALYSIS BY MATRIX METHODS (INCLUDING A PROGRAMMER'S MANUAL AND A USER'S MANUAL) Final Report
Paris Genalis Jul. 1970 270 p refs
(AD-716412; Rept-3397) Avail: NTIS CSCL 13/10

The determination of displacements and stresses in a propeller blade under the influence of a hydrodynamic pressure load is investigated. Also a simplified approach to the free, undamped vibration of the blade is suggested. The finite element method of analysis is used to analyze the blade as a shell or as a combination of a three dimensional solid and a shell. For the vibration problem, the complete blade was idealized by shell element only. Constant stress tetrahedra and rectangular prism elements were used for the analysis of the three dimensional solids. A combination of both kinds of elements was found to cause no algorithmic difficulties or inaccuracies in the results and to provide the flexibility to approximate irregular boundaries by the tetrahedron. The stiffness of the shell element was obtained by the superposition of the stiffness of the plane stress element and the fully compatible plate bending element. Author (GRA)

N71-19827*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
THERMAL-FATIGUE RESISTANCE OF 15 HIGH-TEMPERATURE ALLOYS DETERMINED BY THE FLUIDIZED-BED TECHNIQUE
David A. Spera, Maurice A. H. Howes, (IIT Res. Inst., Chicago) and Peter T. Bizon [1971] 33 p refs Presented at the Western Metal and Tool Exposition, Conf., Design and Sci. Precision Instr. Exhibit (WESTEC), Los Angeles, 8–11 Mar. 1971; sponsored by Am. Soc. for Metals
(NASA-TM-X-52975) Avail: NTIS CSCL 13M

Thermal-fatigue tests were conducted on B 1900, IN 100, IN 100DS (directionally solidified), MM 200, MM 200 DS, In 162, IN 713C, M22 TAZ 8A, U 700 (wrought and cast), TD NiCr, X 40, WI 52, and MM 302. Alloys B 1900, IN 100, and IN 100 DS were also tested with aluminide coating. Among the 18 materials tested, cycles to cracking differed by more than two orders of magnitude. Coating and directional solidification were of definite benefit. However, the directionally solidified alloys suffered considerable weight loss through oxidation. Cycles to cracking were calculated theoretically for IN 100 and B 1900, coated and uncoated, and were in agreement with the data. Author

N71-19828# California Univ., Berkeley. Div. of Applied Mechanics.
REINFORCED MATERIALS WITH THERMO-MECHANICAL CONSTRAINTS
J. A. Trapp 1970 32 p refs
(Contract N00014-69-A-0200-1008)
(AD-716037) Avail: NTIS CSCL 20/11

The paper contains a class of exact (controllable) solutions for materials subjected to thermo-mechanical constraints. The constraints are intended to model materials reinforced with cords. The thermomechanical constraints examined consist of the natural extensions of the purely mechanical constraints of incompressibility and inextensibility to thermomechanical problems along with a purely thermal constraint on the temperature gradient. The solutions found are controllable in that they can be sustained in every isotropic homogeneous simple material by surface tractions and heat fluxes alone. The solutions are independent of all the response functions of the material except those appearing in the constraint equations. Author (GRA)

N71-19829# Catholic Univ. of America, Washington, D.C. Stress Analysis Lab.
ON THE EFFECT OF INITIAL STRESS ON THE PROPAGATION OF FLEXURAL WAVES IN ELASTIC RECTANGULAR BARS
J. A. Clark, A. J. Durelli, and P. A. Laura Dec. 1970 33 p refs
(Contract N00014-67-A-0377-0011)
(AD-716466; Rept-25) Avail: NTIS CSCL 20/11

The dynamics of continuous media subjected to initial stress is of great interest in several fields of applied science and technology; geophysics, oceanography, underwater acoustics and structural design. Pioneering analytical work in this field was done by M. A. Biot. Few contributions have been made, however to the experimental treatment of the problem of determining dynamic stress distributions within statically prestressed continuous media. The present paper deals with an experimental analysis of the propagation of flexural waves in prismatic, elastic bars with and without prestressing. The effects of prestressing by axial tension, axial compression and pure bending are illustrated. Comparisons are made with an approximate theory. The results are extended to bars of other materials by scaling laws. Author (GRA)

N71-19856# Michigan Univ., Ann Arbor. Dept. of Naval Architecture and Marine Engineering.
ELASTIC STRENGTH OF PROPELLERS: AN ANALYSIS BY MATRIX METHODS Final Report

Paris Genslis (Ph.D. Thesis) Nov. 1970 219 p refs
(Contract N00014-67-A-0181-0017)
(AD-716463; Rept-101) Avail: NTIS CSCL 13/10

The determination of displacements and stresses in a propeller blade under the influence of a hydrodynamic pressure load is investigated. Also a simplified approach to the free, undamped vibration of the blade is suggested. The finite element method of analysis is used to analyze the blade as a shell or as a combination of a three dimensional solid and a shell. For the vibration problem, the complete blade was idealized by shell elements only. Constant stress tetrahedra and rectangular prism elements were used for the analysis of the three dimensional solids. A combination of both kinds of elements was found to cause no algorithmic difficulties or inaccuracies in the results and to provide the flexibility to approximate irregular boundaries by the tetrahedron. The stiffness of the shell element was obtained by the superposition of the stiffness of the plane stress element and the fully compatible plate bending element. The results using only the shell element were good both for the static and the dynamic problems. It was felt that with comparable meshes the shell element was more powerful than either of the three dimensional elements. Author (GRA)

N71-19887# National Aeronautical Establishment, Ottawa (Ontario).
A FRACTOGRAPHIC STUDY OF THE FATIGUE FAILURE OF AIRCRAFT WHEELS
W. Wiebe Nov. 1970 46 p refs
(NRC-11694; LR-541) Avail: NTIS

A survey of aircraft wheel failures, and a review of the parameters involved in the qualification tests for aircraft wheels, have indicated a need for accurate information concerning wheel service loading conditions in order to formulate realistic wheel fatigue test spectra. The fractographic examination of three types of wheels from modern aircraft has emphasized the significance of corrosion in the nucleation of fatigue cracks, and has indicated that landing impact loads and brake applications at high speeds may contribute to the growth of the cracks. Several types of macroscopic growth bands or lines that are frequently observed on the fatigue fracture surfaces of laboratory specimens and of components that have failed in service, have been cited and described. Those lines observed on the fracture surfaces of the failed wheels were correlated with crack growth during aircraft landing cycles. The derivation of fatigue crack growth rate information from these lines has facilitated the revision of wheel inspection schedules with the purpose of preventing the catastrophic failure of aircraft wheels. Author

N71-19888# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLIED METHODS OF CALCULATION OF SHELLS AND THIN-WALLED CONSTRUCTION
A. S. Avdonin 6 Nov. 1970 510 p refs Transl. into ENGLISH of the book "Prikladnye Metody Rascheta Obolochek Tonkostennykh Knostruktsii" Moscow, Mashingostroyeniye, 1969 p 1-402
(AD-716527; FTD-MT-24-182-70) Avail: NTIS CSCL 20/11

The book discusses calculation concerning shells of revolution and elements of thin-walled constructions for strength, rigidity and stability under various forms of force action. Such problems include, for example, calculations of doughnut-shaped shells, loaded by internal pressure, spherical shells, loaded by local loads, etc. Problems of stability of shells are given in the book in a new formulation. The conditions on the contour of half-waves are determined by loading conditions and the proposed form of loss of stability. The new approach to these problems refines and expands the concept of stability of shells and gives the possibility of solving practically important problems. GRA

N71-19889# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Lab.
INFLUENCE OF SHEAR COUPLING IN CYLINDRICAL BENDING OF ANISOTROPIC LAMINATES Technical Report, Sep. 1969—Apr. 1970
N. J. Pagano Oct. 1970 39 p refs
(AD-716390; AFML-TR-70-128) Avail: NTIS CSCL 20/11

Investigation of the success of classical lamination theory in predicting the response of composite laminates under static bending is extended by consideration of the influence of shear coupling. Specifically, we treat the exact solution of the problem of a pinned-end laminate composed of N layers, each of which possesses only a single plane of elastic symmetry, under cylindrical bending. Several example problems, involving unidirectional and angle-ply composites, are solved and the detailed results compared to corresponding approximate solutions. Some observations are offered in regard to the general range of validity of classical laminated plate theory. Author (GRA)

N71-19890# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
REFINEMENTS IN THE APPROXIMATE ANALYSIS OF WEB STIFFENED SANDWICH STRUCTURES
Youl-Nan Chen, Frank Cicero, and Joseph Kempner Nov. 1970 55 p refs
(Contract N00014-67-A-0438-0007)
(AD-716394; PIBAL-70-45) Avail: NTIS CSCL 20/11

Present in this work is a method of construction of approximate functions in connection with the energy formulation of certain eigenvalue problems of web-stiffened sandwich structures. The construction is based, upon the method of Young together with a group of fundamental functions deduced from Timoshenkos flexural equations for elastic beams. The analysis is exemplified and numerically tested by the eigenvalue problems of free vibrations and buckling of one-dimensional sandwich structures. Results indicate that the present method possesses marked advantages over similar constructions oriented from the classical flexural normal modes of Bernoulli-Euler. Author (GRA)

N71-19891# Naval Civil Engineering Lab., Port Hueneme, Calif.
AIR BLAST WAVE ATTENUATOR DEVELOPMENT Technical Report, Jul. 1967—Jun. 1970
D. E. Williams Nov. 1970 30 p refs
(AD-716013; NCEL-TN-1128) Avail: NTIS CSCL 13/13

A passive air shock wave attenuator has been proven effective--up to 80% shock front attenuation--over a variety of input conditions and a wide range of overpressures from 10 psi to 3000 psi. Pure viscous attenuation was studied by using square wave inputs. Peaked wave inputs, which attenuate more rapidly, but are more realistic simulations of nuclear blast waves were also studied. Normal airflow resistance was considered carefully since most passive devices are unduly restrictive. A tradeoff between acceptable normal flow resistance and blast wave attenuation, based upon experimental work and a limited facility requirement study, leads to a length to diameter ratio of 300 for most applications. Finally, attenuator configurations are proposed design were considered. A variety of configurations are proposed, the most promising of which, from a fabrication viewpoint, is a parallel plate arrangement. However, the potential of this configuration has not been confirmed experimentally. Author (GRA)

N71-19892# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
ELASTIC PLASTIC ANALYSIS BASED ON A STRESS GRADIENT DEPENDENT YIELD CONDITION
Sharad A. Patel and B. Venkatraman Nov. 1970 27 p ref
(Contract N00014-67-A-0438-0006)
(AD-716050; PIBAL-70-48) Avail: NTIS CSCL 20/11

The elastic-perfectly plastic behaviors of a hollow spherical shell under internal pressure and the pure torsion of a solid circular cylinder are investigated in the present report. These investigations

are based on a modified form of the Mises yield condition in which the effects of stress gradients are taken into account. The report concludes with a brief discussion of the result. Author (GRA)

N71-19873# National Aerospace Lab., Tokyo (Japan).
EXPERIMENTAL INVESTIGATION OF FATIGUE STRENGTH OF AXIAL FLOW COMPRESSOR BLADE ROOT: PIN JOINT LUG HAVING CLEARANCE BETWEEN PIN AND PIN HOLE
Tameji Ikeda and Takashi Yamagishi Sep. 1970 21 p refs In JAPANESE; ENGLISH summary
(NAL-TR-214) Avail: NTIS

Fatigue tests of single lug specimens made for J.I.S. A 3 P2-T 3 aluminum alloy were carried out, varying the clearance between the pin and pin-hole, under repeated or fluctuating tensile load cycle. The fatigue strengths of the lug obtained from the fatigue tests are as follows: (1) these of the lug having large clearance are about 1/3 of the plain specimens of the lugs, (2) those of the lug having very small clearance are always higher than for large clearance under lower values of endurance N, and (3) those of the lug having very small clearance under the higher values of endurance N, give a complicated behavior depending on the far-too-small clearance under a given load, higher over loads for a given clearance, or non-uniform contact between the pin and pin-hole. Author

N71-19874# Forest Products Lab., Madison, Wis.
MINIMAL WEIGHT STRUCTURAL SANDWICH
Edward W. Kuenzi Nov. 1970 19 p refs Revised Supersedes AD-473673
(Contract F33615-70-M-5000)
(AD-715989; AD-473673; FSRN-FPL-086-Rev) Avail: NTIS CSCL 13/13

The report presents theoretical analyses for determination of dimensions of structural sandwich of minimum weight that will have certain stiffness and load-carrying capabilities. It includes a brief discussion of the resultant minimum weight configurations. Author (GRA)

N71-19889# Ohio State Univ. Research Foundation, Columbus.
THE EFFECT OF STRESS RELAXATION ON COMPLEX MODULUS MEASUREMENTS Summary Report, May -Jul. 1970
K. K. Stevens Wright-Patterson AFB, Ohio AFML Oct. 1970 41 p refs
(Contract F33615-69-C-1001)
(AD-716424; AFML-TR-70-230) Avail: NTIS CSCL 20/11

The governing equations of motion for the shear response of a viscoelastic specimen subjected to initial stresses are presented. It is shown that relaxation of the initial stresses leads to apparent complex moduli which increase with time. This explains various time dependent anomolies observed experimentally by Fitzgerald. The effect on the real part of the apparent complex modulus is typically small. The effect on the imaginary part is more pronounced and can, under certain conditions, lead to an apparent negative material damping. The implications of these findings with regard to material testing are discussed. Author (GRA)

N71-19890# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONSTATIONARY OSCILLATIONS OF MECHANICAL SYSTEMS
Ye. G. Golosoke et al 29 Oct. 1970 435 p refs Transl. into ENGLISH of the publ. Nestatsionarnyye Kolebaniya Mekhanicheskikh Sistem' Kiev, 1966 p 1-336
(AD-716528; FTD-HC-23-1292-68) Avail: NTIS HC $6.00/MF $0.95 CSCL 20/11

Results of investigations of transient processes of linear systems with any number of degrees of freedom (rods, shafts, plates and disks) are presented. Nonstationary oscillation systems described by equations with periodically changing coefficients and the nonstationary oscillations of nonlinear systems were studied with the aid of the Yu. A. Mitropolsky method and with direct integration of equations. Considerable attention was paid to nonstationary flexural vibration in shafts and to nonstationary vibrations of systems with restricted excitation. As examples, numerous problems were solved with the aid of a digital computer. Author (GRA)

N71-19891# Naval Research Lab., Washington, D.C.
SIGNIFICANCE OF FRACTURE EXTENSION RESISTANCE (R-CURVE) FACTORS IN FRACTURE-SAFE DESIGN FOR NONFRANGIBLE METALS Special Summary and Interpretive Report
W. S. Pellini and R. W. Judy, Jr. 19 Oct. 1970 44 p refs
(AD-716407; NRL-7187) Avail: NTIS CSCL 13/13

Requirements for new directions in fracture research emerge from considerations of the basic lack of applicability of K parameters for definition of the fracture extension resistance of nonfrangible metals. New research is required into factors relating to the increase in plastic work energy resistance defined by R curves. The urgency of such studies evolves from the increasing use of metals of low-intensity plane stress (low-shelf low-tearing-energy) characteristics in structures of high-compliance features. A case is presented for the mutual consideration of metal-type structure-type relationships in fracture-safe design. Present fracture-safe design practices do not include a rational approach to this question. The report provides an introduction to these considerations in terms of extension of fracture mechanics concepts, as well as metallurgical factors and engineering practices. The importance for understanding the interaction of these factors cannot be overstated, and considerable emphasis is placed on introductory aspects. Data presentation of R-curve research is limited to illustrative examples, which document the reality of fracture extension processes in determining conditions for structural failure. The report is intended as a precursor to topical reports on the subject. A rationale is presented for the use of the Dynamic Tear test in standard and modified configurations, which provide for definition of R-curve features. Indexing of the R-curve features to the Ratio Analysis Diagram (RAD) adds new dimensions to analytical capabilities of this system. Author (GRA)

N71-19918# Gulf General Atomic, San Diego, Calif.
RESEARCH ON GRAPHITE A Three-Year Summary Report, 15 May 1967 -14 May 1970
G. B. Engle, R. J. Price, J. C. Bokros, and J. L. White 1 Jun. 1970 117 p refs
(Contract AT(04-3)-167)
(GA-9975) Avail: NTIS

Research directed toward an understanding of the relationships between the properties, microstructure, and irradiation behavior of the various carbonaceous and graphitic materials required for use in high-temperature reactors of advanced design and thus to provide a basis for substantial improvements in fabrication and the service behavior of these materials is summarized. The materials studied were composed of carbon in a wide variety of structures, ranging from nearly amorphous forms to highly crystalline states. The experimental work consisted of studies on carbonization, catalytic graphitization, characterization of microstructures, and irradiation of the various materials. The research efforts were directed toward defining the structure of the various materials, learning the relations between structure and properties relevant to reactor applications, and evaluating methods for the preparation of new or modified structures with improved properties. NSA

N71-19919# Ballistic Research Labs., Aberdeen Proving Ground, Md.
COLLOCATED INTERFACIAL STRESS INTENSITY

FACTORS FOR FINITE, BI-MATERIAL PLATES
Stephen Gerard Sawyer Sep. 1970 30 p refs
(AD-716334; BRL-1498) Avail: NTIS CSCL 20/11

The paper examines elastic stress intensity factors associated with partially debonded interfaces in finite, bi-material plates. Bi-material stress intensity factors K(1) and K(2) are functions of an arbitrary length parameter; certainly any fracture condition involving bi-material stress intensity factors must be independent of a length parameter as in the homogeneous case. One defines a new quantity K(i) called the interfacial stress intensity factor which is independent of an arbitrary length parameter. A truncated Williams power series stress function for stresses in a cracked bi-material plate, as modified by Sih and Rice, is used with an improved boundary collocation procedure to generate interfacial stress intensity factors for finite bi-material plates. This modified collocation technique eliminates the need for tuning the boundary points. The method is exemplified by application to a centrally cracked bi-material plate and to a partially debonded composite laminate. Author (GRA)

N71-19975# Ballistic Research Labs., Aberdeen Proving Ground, Md.
DERIVATION OF GENERALIZED FOURIER SERIES FOR CALCULATING STRESSES IN SEMI-INFINITE STRIPS AND CYLINDERS
Alexander S. Elder Nov. 1970 40 p refs
(AD-716338; BRL-1510) Avail: NTIS CSCL 20/11

Generalized Fourier series for calculating stresses in semi-infinite elastic strips and cylinders are derived in this report. In all cases the solutions are expressed in terms of the Papkovitch-Fadle eigenfunctions; a complete solution is thus obtained without using additional sets of orthogonal functions. Certain mixed boundary value problems have been solved in closed form by using the inner biorthogonal properties of the eigenfunctions. In all other boundary value problems, the Fourier coefficients are obtained by solving a set of linear equations. This investigation provides a common analytical basis for calculating stresses in semi-infinite strips and cylinders. Author (GRA)

N71-19979# Washington State Univ., Pullman. Dept. of Physics.
AXISYMMETRIC ELASTIC WAVE PROPAGATION IN BARS CONTAINING A DISCONTINUITY
John Lee Habberstad Sep. 1970 230 p refs
(Grant AF-AFOSR-1758-69)
(AD-716547; WSU-SDL-70-04; AFOSR-70-2828TR) Avail: NTIS CSCL 20/11

The objective of the work is to obtain a solution to the axisymmetric equations of motion in an elastic bar containing various discontinuities. The differential equations governing axisymmetric, elastic wave propagation are derived in displacement form. The resulting equations are cast in an explicit finite difference scheme and integrated numerically to obtain solutions for the displacements and stresses which are valid throughout the length of the bar. The first problem considered is a pressure shock applied to the end of a constant diameter, semi-infinite bar having a free radial surface. The resulting displacements are compared to Bertholfs numerical work and Miklowitz and Nisewangers experimental data. The next problem studied is the case of a pressure shock applied to the end of a uniform diameter bar composed of two materials fused together at some point along the bars length. The continuity conditions on stress and displacement at the material junction are cast in finite difference form to allow the numerical integration to proceed across the material junction. The last problem examined is elastic wave transmission in a bar containing a discontinuity in cross section at some point along its length. The numerical method is used to study the case of a pressure shock applied to either the large or small end of the bar. Author (GRA)

N71-19999# California Univ., Livermore. Lawrence Radiation Lab.
LONGITUDINAL MODES IN A VIBRATING BAR
James H. Morehouse (Ph.D. Thesis) Nov. 1970 82 p refs Sponsored by AEC
(UCRL-50947) Avail: NTIS

Radial variation of longitudinal displacement in a vibrating bar was investigated experimentally and analytically. Sinusoidal resonance was used to isolate single mode shapes at several frequencies. The modal contours were measured with the use of an ultrasonic crystal and the data were normalized and plotted. The Pochhammer-Chree treatment of a vibrating solid elastic cylinder provided the analytical prediction of the mode shapes. Solutions corresponding to the first, second, and third modes were measured in the frequency range of 30 to 140 kHz in a 2-in. diam aluminum bar. Examples of displacement contours encountered up to 300 kHz are included but do not match calculated mode shapes. The failure of the Pochhammer-Chree theory in resonant bars due to shear stress residuals is discussed. Author

N71-20000# California Univ., Livermore. Lawrence Radiation Lab.
CRACK ARREST IN TRANSVERSELY LOADED ELASTIC PLATES
D. O. Harris and A. S. Tetelman 11 Mar. 1970 38 p refs Presented at the 3d Natl. Symp. on Fracture Mech., Pittsburgh, Aug. 1970 Submitted for publication Sponsored by AEC
(UCRL-72335; CONF-700830-1) Avail: NTIS

An experimental study is described on arresting running cracks under oppositely located circular zones of externally applied transverse compression. Experiments were conducted on precracked, single-edge-notched plate specimens of high-strength steel, subjected to both in-plane tension stress and transverse compression loads. Side loads of various magnitudes were applied and the specimens than pulled in tension. Crack arrest occurred if the side load was sufficiently large. The loads required for crack arrest were compared with theoretical predictions. Excellent agreement was observed between the experimental and theoretical results. The primary conclusions obtained from the theory were that transverse loading zone diameters equal to the plate thickness are nearly optimum for arresting cracks, and that the load required for arrest increases with fracture toughness. Author

N71-20029# Arizona Univ., Tucson. Dept. of Aerospace and Mechanical Engineering.
INTERACTIONS AMONG THE VARIOUS PHENOMENA INVOLVED IN THE DESIGN OF DYNAMIC AND ROTARY MACHINERY AND THEIR EFFECTS ON RELIABILITY Technical Report, 1 Feb. 1969 - 31 Aug. 1970
Dimitri Kececioglu and Edward B. Haugen 31 Aug. 1970 261 p refs
(Contract N00014-67-A-0209-0002)
(AD-716017; TR-3) Avail: NTIS CSCL 13/9

The realization that in mechanical components stress, strength, and the factors that modify them are by nature distributed has pointed to the need for design methods that incorporate the unique powers of the theories of probability and statistics. Furthermore, since with any designed product of mechanical nature a finite probability of failure is associated, this suggests that another probability, called reliability, must be the logical measure of design adequacy of such products. As the design of reliable and optimized components and systems of dynamic and rotary machinery is becoming a matter of increasing concern, methods by which a specified level of reliability can, in an a priori manner, be designed into a component assume great importance. So also does the existence of supporting design data in distributional form. Author (GRA)

N71-20103# Illinois Univ., Urbana. Dept. of Civil Engineering.
FINITE ELEMENT ANALYSIS OF TRANSLATIONAL SHELLS
Tzu-cheng Chu and William C. Schnobrich Nov. 1970 133 p refs *Its* Structural Res. Ser. No. 368
(Contract N00014-67-A-0305-0010)
(AD-716561) Avail: NTIS CSCL 20/11

A finite element procedure is presented for solving thin shell problems of arbitrary geometry and boundary conditions. The actual smoothly curved shell surface is approximated by the assemblage of flat triangular plate elements. Both the membrance stiffness and plate bending stiffness of the flat element are considered and it is assumed that there is no coupling between these two types of element stiffness properties. The element stiffness properties are derived from assumed displacement functions, and triangle area coordinates are used for the derivation. A quadratic displacement function for the tangential displacements in the triangular element is assumed and the membrance stiffness is derived according to this assumed displacement function. A complete fourth order displacement function is used to derive the flexural stiffness of the triangular element. Shell or plate which is supported by edge beams or is stiffened by stiffeners is discussed. The twisting and axial stiffnesses, the eccentricity and the bending stiffness of the beam element are all considered. Various numerical examples are presented. These examples demonstrate the versatility and the accuracy given by the finite element procedure presented in this study. Author (GRA)

N71-20107# Aeronautical Research Labs., Melbourne (Australia).
CONSIDERATIONS RELEVANT TO LOWER YIELD STRESSES
M. M. Hutchison Jul. 1970 18 p refs
(ARL/MET-71) Avail: NTIS

The significance of the macroscopically inhomogeneous nature of yield propagation and of various features of the yield region of load-elongation curves is discussed. It is shown that the important rate parameter during yield propagation is the velocity of the Luders front and not the overall applied strain-rate. Hence comparison of yield and general flow stresses should only be made after due consideration of the different local strain-rates resulting from differences in homogeneity of deformation. The yield stresses of Armco Iron have been determined at constant Luders front velocities for various grain sizes. When plotted against the square root of grain size, the intercepts at infinite grain size are smaller and not as strain-rate dependent, and the slope of the relationships (K sub y) are much more strain-rate dependent, than for yield stress-square root of grain size relationships found using yield stresses determined at constant (applied) elongation rate. Author

N71-20108# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE BASES OF THE STRUCTURAL MECHANICS OF ROCKETS
L. I. Balabukh et al 30 Oct. 1970 829 p refs Transl. into ENGLISH of the book "Osnovy Stroitelnoi Mekhaniki Raket" Moscow, Vysshaya Shkola, 1969 p 1-494
(AD-716511; FTD-MT-24-124-70) Avail: NTIS CSCL 19/7

The bases of the structural mechanics of rockets are stated in the form of a complex of problems associated with an analysis of the working capacity of the forces of elements in rocket structures. The necessary knowledge from the theories of elasticity and plasticity, the theory of a casing, as well as the bases of dynamic and temperature calculations of rocket structures and rocket engines, are presented. Special attention is given to the analysis of active loading and to the selection of actual elements of structures (tanks, compartments, nose cone sections, engines) of the most undesirably calculated cases. Methods of constructing by dynamic temperature calculations, and calculations of strength are illustrated by numerous examples. Author (GRA)

N71-20111# California Univ., Berkeley.
ON UNIQUENESS IN THE LINEAR THEORY OF ELASTIC SHELLS AND PLATES
A. E. Green and P. M. Naghdi (Oxford Univ., England) 1970 21 p refs
(Contract N00014-69-A-0200-1008)
(AD-716015) Avail: NTIS CSCL 20/11

A recent paper by the authors contains an approximate linear theory for thermoelastic shells (and plates) which is derived from the three-dimensional equations. Under isothermal conditions, the equations of this theory are of the same form as those of a linear theory of elastic Cosserat surface. The present paper is mainly concerned with a uniqueness theorem for the solution of the initial mixed boundary-value problem characterized by the equations of the above mentioned theory for thermoelastic shells. Author (GRA)

N71-20128# Advisory Group for Aerospace Research and Development, Paris (France).
STRUCTURAL DESIGN APPLICATIONS OF MATHEMATICAL PROGRAMMING TECHNIQUES
G. G. Pope and L. A. Schmit, eds. Feb. 1971 203 p refs
(AGARD-AG-149-71; AGARDOGRAPH-149) Avail: NTIS

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12. OPTIMIZATION TECHNIQUES IN AIRCRAFT CONFIGURATION DESIGN B. Silver and H. Ashley p 174-194 refs (See N71-20140 09-32)

N71-20129# Advisory Group for Aerospace Research and Development, Paris (France).
INTRODUCTION AND BASIC CONCEPTS
L. A. Schmit and G. G. Pope *In its* Structural Design Appl. of Mathematical Programming Tech. Feb. 1971 p 2-13 refs (See N71-20128 09-32)
Avail: NTIS

The application of mathematical programming methods to aerospace structural design is discussed. The fundamental ideas are illustrated by considering the elementary examples of a simply supported column and a two-bar truss. The traditional approach to least weight design of aircraft structures is stated to be formulating

the optimization problem in terms of equations, and a variation is the reduction of the objective function to one of a single variable. Terminology used in mathematical programming is defined and the main features in applying the techniques to structural design are outlined. Mathematical programming techniques applied to materials selection is usually characterized by a discrete set of available materials, even for composite materials. N.E.N.

N71-20130# Advisory Group for Aerospace Research and Development, Paris (France).
A BASIS FOR ASSESSING THE STATE OF THE ART
L. A. Schmit *In its* Structural Design Appl. of Mathematical Programming Tech. Feb. 1971 p 14–29 refs (See N71-20128 09-32)
Avail: NTIS

The design philosophy in combining computer oriented structural analysis with mathematical programming methods is described. One approach to the problem is to design the structure so that initial yielding under service load conditions is avoided, and another is to design so as to prevent collapse under service load conditions. Design variables and weight minimization as the objective function are described. Formulations are discussed, and include sequence of linear programs, sequence of unconstrained minimizations, basic nonlinear programming, and classical formulation of the inequality constrained minimization problem. N.E.N.

N71-20131# Advisory Group for Aerospace Research and Development, Paris (France).
CLASSICAL OPTIMIZATION THEORY RELEVANT TO THE DESIGN OF AEROSPACE STRUCTURE
G. G. Pope *In its* Structural Design Appl. of Mathematical Programming Tech. Feb. 1971 p 30–33 refs (See N71-20128 09-32)
Copyright. Avail: NTIS

Design optimization of aerospace structures, which must behave elastically under service conditions, is discussed. The classical theorem which is applicable directly to the least weight design of highly idealized frameworks is emphasized. It is assumed that the structure is fabricated from an elastic/perfectly plastic material, and the basic theory for single and multiple load conditions is given. The optimum layout of least weight, elastic frameworks and general properties are described. N.E.N.

N71-20132# Advisory Group for Aerospace Research and Development, Paris (France).
LITERATURE REVIEW AND ASSESSMENT OF THE PRESENT POSITION
L. A. Schmit *In its* Structural Design Appl. of Mathematical Programming Tech. Feb. 1971 p 34–45 refs (See N71-20128 09-32)
Avail: NTIS

A selective review of articles on mathematical programming applications to structural design optimization, limited to finite problems, is presented. An effort is made to trace the development of programming applications, and papers thought to have strongly influenced this development are discussed. Current and future trends are also described, and brief reviews are given on structural optimization in the dynamic response regime and reliability based structural optimization. N.E.N.

N71-20138# Advisory Group for Aerospace Research and Development, Paris (France).
OPTIMIZATION OF STRUCTURES WITH RELIABILITY CONSTRAINTS
F. Moses *In its* Structural Design App. of Mathematical Programming Tech. Feb. 1971 p 126–143 refs (See N71-20128 09-32)
(Grants NSF GK-74; NSF GK-1871)
Avail: NTIS

The relationship between optimum design of structure as it is now formulated in almost classical terms and reliability or safety of structures is studied. The kinds of structures for which reliability or failure probability can reasonably be analyzed and have been presented particularly in a redesign or optimization procedure are discussed. As the topic concerns safety in a probabilistic framework some attention is given to relevant questions of probability sensitivity, failure costs, limited empirical information, analysis errors, and safety philosophy. Several examples of optimization with reliability or failure probability constraints are presented. Author

N71-20139*# Advisory Group for Aerospace Research and Development, Paris (France).
OPTIMIZATION UNDER AEROELASTIC CONSTRAINTS
H. Ashley, S. C. McIntosh, Jr., and W. H. Weatherhill *In its* Structural Design Appl. of Mathematical Programming Tech. Feb. 1971 p 144–173 refs Sponsored by NASA and the AF (See N71-20128 09-32)
(NASA-CR-117198) Avail: NTIS CSCL 20K

Two major lines of development in the optimization of aeroelastic constraints for high performance aircraft design are discussed. The optimization of problems with one-dimensional space variable can be identified as a variational problem and reduced to systems of first-order ordinary differential equations. Discretization by assumed-mode and finite element methods are also described, and the control variables are replaced with a finite vector of n adjustable element properties. Minimization of the chosen merit function amounts to a search of n-vectorspace. Mathematical discussions of examples are given for each method, and the importance of each method in future development is indicated. N.E.N.

N71-20140# Advisory Group for Aerospace Research and Development, Paris (France).
OPTIMIZATION TECHNIQUES IN AIRCRAFT CONFIGURATION DESIGN
B. Silver and H. Ashley *In its* Structural Design Appl. of Mathematical Programming Tech. Feb. 1971 p 174–194 refs (See N71-20128 09-32)
Avail: NTIS

Parametric analysis and automated search methods for preliminary design optimization are compared, and methods of optimization that go beyond parametric analysis are investigated. Indirect methods, such as the calculus of variations, are mentioned. Direct methods of optimization are discussed including selection of design variables, constraint formulation, methods with and without derivatives, one dimensional search methods, and convergence criteria. The indirect methods solve auxiliary problems, while the direct methods adopt a hill-climbing strategy on the objective function directly. Operational results of direct search methods are given, and the field of man-computer interactive design is briefly described. N.E.N.

N71-20176# Battelle Memorial Inst., Columbus, Ohio.
STRESSES IN OUT-OF-ROUND PIPE DUE TO INTERNAL PRESSURE. PHASE REPORT NO. 118-8
E. C. Rodabaugh Jan. 1971 70 p
(Contract W-7405-eng-26)
(ORNL-TM-3244) Avail: NTIS

A nonlinear strength of materials formulation was developed for the elastic bending stresses caused by internal pressure in an out-of-round pipe. The formulation is based on the assumptions that thin-walled shell theory is valid and that deviations from a circular cross-sectional shape are small in comparison with the average radius of the pipe. For the general solution, both the initial cross section and the deformed shape are represented by Fourier sine-cosine series. Elliptical cross-sections and cross-sections which have either flat spots or peaks are treated as special cases of the general nonlinear solution. The results obtained using the analytical

method are compared with experimental results with good agreement. Comparisons are also made with published linear analyses for the elliptical cross-sections and for the cross sections with a peak. The nonlinear analysis gives generally lower maximum stress values. Author (NSA)

N71-20229# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.

LIFE TESTING USING CONTINUOUS ACCELERATION

E. Rabinowicz and B. Shiralkar (GE, San Jose, Calif.) *In* NBS Space Simulation Oct. 1970 p 457–471 refs (See N71-20201 09-11)

Avail: SOD $5.25

One method of carrying out accelerated tests consists of increasing the stress at a uniform rate with time until failure. It is shown that from such tests the life under normal stress conditions can be predicted by plotting the results on a stress-time curve on which the stress axis has been modified so that area represents amount of damage. Tests with electric light bulbs, whose failures obey a cumulative damage criterion, give good agreement between predicted and measured life. The danger of the continuous acceleration procedure is that the stress may become so high that new failure modes are introduced. Author

N71-20232# Washington Univ., St. Louis, Mo.

SOME EFFECTS OF EQUALIZATION ON ACCELERATION RESPONSE AND FATIGUE LIFE EXPECTANCY

R. M. Mains *In* NBS Space Simulation Oct. 1970 p 509–524 refs (See N71-20201 09-11)

Avail: SOD $5.25

A set of calculations is reported for various transmissibilities of a 10-mass system, intended to be representative of an exciter, fixture, test article arrangement. The difficulties of achieving equlization at some coordinate when it has a transmissibility range of 1 million or more are noted. By comparison of r.m.s. responses to a level power spectral density input, it is shown that factors of 5 to 10 or more difference in acceleration response result from equalization at different coordinate locations. These differences in rms response would produce corresponding differences in predicted real time behavior. The differences in rms spring stress responses were smaller for various equlaization locations, but still large enough that predictions of fatigue life expectancies are affected by the choice of equalization location. Author

N71-20463*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

THE PROBLEM OF AN ELASTIC LAYER WITH A CYLINDRICAL HOLE SUBJECTED TO A NONUNIFORM AXISYMMETRIC RADIAL DISPLACEMENT

David Stuart Grissom (M.S. Thesis–Houston Univ.) [1971] 82 p refs

(NASA-TM-X-58056) Avail: NTIS CSCL 20K

A problem in the linear theory of elasticity is considered wherein a layer with a circular cylindrical hole is subjected to a nonuniform radial displacement. The deformation is imposed on the cylindrical boundary such that axisymmetric displacements and stresses result. The solution utilizes Navier's equations of elasticity. These equations are solved by use of extended Hankel transforms to obtain displacements. Shear and longitudinal stresses are obtained by transformed stress-strain relationships. Radial and circumferential stresses, however, are obtained directly by use of stress-strain equations. The solution of a problem where the imposed radial displacement is a linear function of the axial coordinate is presented. Numerical results are given in graphical form for two different ratios of hole radius to layer thickness. The infinite integrals of the inversion formulas were evaluated numerically using Longman's technique for computing infinite integrals of oscillatory functions. Author

N71-20464# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.

PLASTIC STABILITY OF ARCHES: RECONSIDERATION OF A MODEL

Steven C. Batterman (Pennsylvania Univ.) Jan. 1971 30 p refs Sponsored in part by NSF

(TAE-119) Avail: NTIS

A model for plastic buckling of three hinged arches is reconsidered. Calculations are presented for the idealized geometrically perfect structure and for realistic imperfect structures. The linear work-hardening material stress-strain behavior accounts for reverse plastic flow in tension and its effect on load-deflection behavior. For the perfect system it is shown that, in contradistinction to the basic column problem, the asymptotes to the load-deflection curve are functions of the load at which bifurcation begins. For the imperfect system it is shown that as the imperfection parameter approaches zero the arch does not exhibit asymmetric bifurcation as previously thought. Attention is directed at the implications of the analysis towards the founding of a general theory of plastic stability. Author

N71-20482*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. Guidance and Control Div.

MULTI-RIGID BODY ATTITUDE DYNAMICS SIMULATION

Gerald E. Fleischer 15 Feb. 1971 77 p refs

(Contract NAS7-100)

(NASA-CR-117350; JPL-TR-32-1516) Avail: NTIS CSCL 20K

The apparent advantages of the barycenter formulation of rigid body rotational dynamics are described. The end product is a FORTRAN subroutine capable of computing the angular accelerations of each body in a system composed of several point-connected rigid bodies. A 3-body system is used to illustrate the concept of the connection barycenter. Extension of the barycenter formulation of the dynamical equations to the general case of n bodies is then derived. Two space vehicle attitude dynamics and control simulations of some interest are used to illustrate the application of the computer subroutine MLTBDY: one example is a spacecraft, under three-axis control, subject to the perturbations of a mechanically scanning platform, while the other is a rigid space vehicle hinged to four large solar cell panels and under the influence of a trajectory correcting rocket engine. Author

N71-20497# Loughborough Univ. of Technology (England). Dept. of Transport Technology.

VIBRATION CHARACTERISTICS OF A CLAMPED/FREE AND CLAMPED/RING STIFFENED CIRCULAR CYLINDRICAL SHELLS: A THEORETICAL ANALYSIS

C. B. Sharma and D. J. Johns Jan. 1970 106 p refs

(Contract PD/1170/05)

(TT-7001) Avail: NTIS

A theoretical analysis for the free vibration of clamped/free and clamped/ring stiffened cylindrical shells has been developed and programmed for digital computer solution. The analysis is capable of handling vibration characteristics of cylindrical shells, in the swaying (cantilever mode n = 1) as well as in the ovalling or breathing modes (n greater than or equal to 2; n is circumferential wave number), with arbitrary length to radius ratio and radius to thickness ratio. In the case of a shell with an end ring it also allows for variation in the non-dimensional ring characteristics (ring breadth/shell radius, ring depth/shell radius). Three translational shell inertia components are included and the effects of ring eccentricity and mass and rotary inertia are examined. The accuracy of various engineering approximations as compared with more exact solutions from Flugge's thin shell equations are examined and the error in terms of a non-dimensional frequency parameter is discussed. For tall shells the assumption of zero hoop and shear strain leads to considerable simplification in the analysis without introducing any significant error in the minimum natural frequency. Author

N71-20515*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HIGH VELOCITY IMPACT TESTS CONDUCTED WITH POLYETHYLENE TEREPHTHALATE PROJECTILES AND FLEXIBLE COMPOSITE WALL PANELS
Jerry G. Williams Washington Mar. 1971 18 p refs
(NASA-TN-D-6135; L-6998) Avail: NTIS CSCL 20K

Test results are presented for the high velocity impact of 11 mg, 6.4-millimeter-diameter polyethylene terephthalate disk projectiles fired into flexible composite wall panels. Test panels were composed of various flexible fabric, film, and foam materials including polyethylene terephthalate, nylon, fiber glass, fluorinated ethylene propylene, steel wire, rayon, fluoroelastomer, polyurethane, and neoprene. Test velocities ranged from 2.07 to 5.79 km/sec.
Author

N71-20516*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFECT OF ELASTIC END RINGS ON THE EIGENFREQUENCIES OF FINITE LENGTH THIN CYLINDRICAL SHELLS
Michel El Raheb 1 Mar. 1971 33 p refs
(Contract NAS7-100)
(NASA-CR-117312; JPL-TR-32-1489) Avail: NTIS CSCL 20K

The effect of elastic end rings on the eigenfrequencies of thin cylindrical shells was studied by using an exact solution of the linear eigenvalue problem. The in-plane boundary conditions which proved to be very influential in the neighborhood of the minimum frequency were exactly satisfied. The out-of-plane and torsional rigidities of the ring were found to govern the overall shell stiffness. Considerable mode interaction was noticed at low circumferential wave numbers for low values of the ring stiffness. Rings with closed section were found to be more efficient than those with open section for the same values of weight ratio. No appreciable difference was noticed between rings fixed from the inside or the outside of the shell mid-surface.
Author

N71-20517# California Univ., Berkeley. Div. of Structural Engineering and Structural Mechanics.
COMPUTER PROGRAM FOR CELLULAR STRUCTURES OF ARBITRARY PLAN GEOMETRY
K. J. Willam and A. C. Scordelis Sep. 1970 127 p refs Sponsored in part by DOT
(PB-196143; UCSESM-70-10) Avail: NTIS CSCL 13M

A computer program is presented for the analysis of cellular structures of constant depth with arbitrary geometry in plan view. The development is based on the finite element method and uses two different element types designed to capture the main behavior of deck and web components. The structure may be subjected to a variety of force and displacement boundary conditions, such as distributed dead and live-loads in addition to concentrated nodal loads and prescribed nodal displacements. The well established direct stiffness method is used for the element assembly. After solving for the unknown nodal displacements and reactions, internal forces are computed at the center and at nodes of deck and web elements selected by the user.
Author (GRA)

N71-20519# Lockheed Missiles and Space Co., Palo Alto, Calif. Metallurgy and Composites Lab.
FRACTURE BEHAVIOR OF 1/4 INCH THICK 7075-T651 Al CONTAINING SEMIELLIPTICAL SURFACE FLAWS
R. M. Bonesteel 26 Jan. 1971 36 p refs
(Rept-6-83-71-1) Avail: Issuing Activity

The static fracture behavior of surface-flawed and of center-through-crack specimens of 1/4-in.-thick 7075-T651 aluminum plate was investigated. The response of surface-flawed specimens to sustained tensile loading while exposed to aqueous 3-1/2% NaCl solution was also studied. An equation was developed that yielded a constant value of fracture toughness K sub I sub c for the surface-flawed specimens over a wide range of a/t and a/c ratios. Grain boundary delaminations ahead of the periphery were observed following exposure of specimens to the stress-salt water environment. The size of the delamination zone was found to increase with increasing applied stress intensity; the time of exposure was found to be of secondary importance in establishing the size of the delamination zone. Fracturing the specimens in air following exposure to the stress-salt water environment indicated that the delamination process sufficiently blunted the flaws that in all cases except one the calculated fracture toughness increased as a result of the environmental exposure.
Author

N71-20520# Aeronautical Research Labs., Melbourne (Australia).
A NON-LINEAR REGRESSION ARISING FROM INVESTIGATION OF PETCH'S FORMULA FOR PROOF STRESS
D. G. Ford Jun. 1970 16 p refs
(ARL/SM-351) Avail: NTIS

In analysing experiments designed to check the Hall-Petch formula a regression with one non-linear and two linear parameters arose. The fitting of these parameters is described together with an approximate confidence region.
Author

N71-20521# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
NON-LINEAR BEHAVIOUR OF CYLINDRICAL SHELLS UNDER LATERAL PRESSURE LOADINGS
A. M. J. Alnajafi Oct. 1970 31 p refs
(Contract PD/1170/07)
(TT-7003) Avail: NTIS

A program using cylindrical finite elements has been written to solve for non linear large deflections. Wind pressure is approximated by a number of harmonics around the shell using Fourier analysis. The program facilitates the addition of ring stiffeners but this has not been tested. The equations are solved by adding the nonlinear terms to the right hand side assuming they are additional forces.
Author

N71-20522# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
DERIVATION OF STIFFNESS MATRIX FOR A TAPERED BEAM ELEMENT
R. Ali Apr. 1970 24 p refs
(TT-7007) Avail: NTIS

A stiffness matrix for a tapered beam element has been derived. The matrix was proved by predicting the tip deflection of a tapered cantilever beam and comparing it with deflection measured in the laboratory. Comparison was also made with an idealized uniform beam of average cross sectional properties. The stiffness matrix contains expressions which have to be integrated individually for various cross sections. Integration of these expressions for hollow box section, channel section and top hat section are given.
Author

N71-20530*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER CODE FOR THE ANALYSIS OF MULTILAYERED FIBER COMPOSITES: USER'S MANUAL
Christos C. Chamis Washington Mar. 1971 119 p refs
(NASA-TN-D-7013; E-5611) Avail: NTIS CSCL 20K

A FORTRAN 4 computer code for the micromechanics, macromechanics, and laminate analysis of multilayered fiber composite structural components is described. The code can be used either individually or as a subroutine within a complex structural analysis/synthesis program. The inputs to the code are constituent materials properties, composite geometry, and loading conditions. The

outputs are various properties for ply and composite: composite structural response, including bending-stretching coupling; and composite stress analysis, including comparisons with failure criteria for combined stress. The code was used successfully in the analysis and structural synthesis of flat panels, in the buckling analysis of flat panels, in multilayered composite material failure studies, and lamination residual stresses analysis. Author

N71-20543# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
WIND-INDUCED OSCILLATIONS OF CIRCULAR CYLINDRICAL SHELLS: AN EXPERIMENTAL INVESTIGATION
C. B. Sharma and D. J. Johns Jul. 1970 82 p refs
(Contract PD/1170/05)
(TT-7008) Avail: NTIS

A discussion of the wind induced oscillations of tall chimneys is presented with emphasis on the vortex excited motion of tall circular cylindrical shell structures in either the swaying (bending) or the ovalling (breating) modes. The possible relationships between these modal natural frequencies and the frequency spectrum of the aerodynamic input (in this case the frequency of shedding of a pair of vortices) are discussed. A large number of model tests were performed in wind tunnels on the shells clamped at the base and free at the top. Model shells of different lengths and varying thickness and diameter were used, also a mechanical shaker as an excitation device. Measured frequencies are compared with those predicted by the relevant structural vibration analyses given in Part A of this study. In some cases the effect of a stiffening ring at the free end is assessed. An attempt was also made to determine experimentally the structural damping characteristics for various modes of vibration. Author

N71-20544*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
STRESS INTENSITY FACTORS FOR SURFACE FLAWED FRACTURE SPECIMENS Quarterly Status Report
F. W. Smith 30 Sep. 1970 95 p refs
(Grant NGR-06-002-063)
(NASA-CR-114240) Avail: NTIS CSCL 20K

A solution to the problem of a circular crack partially embedded in a solid of finite thickness is presented. A superposition and iteration technique is used to determine the stress intensity factor numerically. The stress intensity factor is determined as a function of position around the crack front for a variety of crack depths and thicknesses. The results of this study are compared to experimental data for a semi-elliptical surface flaw in a brittle material. In addition, a solution for the partially closed Griffith crack is presented. This formulation leads to a closed form solution for the stress and displacement on the plane of the crack. A method for finding the open crack length is presented. The problem of pure bending which closes one end of the crack is solved and the stress intensity factor is calculated. Author

N71-20548# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
DEPARTMENT OF TRANSPORT TECHNOLOGY Research Report, 1970
K. L. C. Legg and D. J. Johns, eds. 1970 121 p refs
Avail: NTIS

Research efforts reported are concerned with: (1) aircraft and missiles; (2) automobiles and heavy road vehicles; (3) surface trains and tube transport vehicles; and (4) marine and tracked hovercrafts. Other topics include problems of industrial aerodynamics relevant to civil engineering structures and their optimization and control. G.G.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N71-19530# United Kingdom Atomic Energy Authority, Harwell (England).
THE HARWELL HEAT TRANSFER AND FLUID FLOW INFORMATION ANALYSIS CENTRE
L. B. Cousins *In AGARD* Inform. Analysis Centres Feb. 1971 (See N71-19526 09-07) 8 p
Avail: NTIS

The establishment of a service to meet the information requirements of a specific group of scientists and technologists is described. The setting up of a reference library for heat transfer and fluid flow literature is outlined, and the methods employed for rapid retrieval of that literature using a large digital computer are given. Author

N71-19650*# Hughes Aircraft Co., Culver City, Calif.
HEAT EJECTION SYSTEM, PART 7
In its Parametric Analysis of Microwave and Laser Systems for Commun. and Tracking, Vol. 3 Feb. 1971 p 525–553 refs (See N71-19643 09-07)
Avail: NTIS CSCL 20M

Thermal control system requirements imposed by spacecraft communications systems are presented. The communications system characteristics which determine the thermal control requirements are: (1) output power, (2) efficiency, and (3) operating temperature of the transmitting source. The thermal control system is also influenced by the mission thermal environment and the spacecraft configuration. The basic requirement is that all heat produced by intermittent operation of the transmitter must be ejected from the spacecraft. Several systems for temperature control are described. Author

N71-19944# Avco-Everett Research Lab., Everett, Mass.
A SHOCK TUBE STUDY OF THE DECOMPOSITION KINETICS OF SO2F2
Kurt L. Wray and Eugene V. Feldman Dec. 1970 28 p refs
(Contract F04701-69-C-0122; ARPA Order 1092)
(AD-716627; AERL-RR-348; SAMSO-TR-70-333) Avail: NTIS CSCL 7/4

Recent thermal decomposition studies of SF6 have led to interest in its principal oxidation product, sulfuryl difluoride. In the present study the thermal stability of SO2F2 at high temperatures has been investigated. Highly dilute SO2F2-Ar mixtures (about 0.1%) were shock heated in a conventional 1.5 in stainless steel shock tube. The SO2F2 concentration was monitored as a function of time behind the incident shock wave by its infrared emission at 11.7 microns utilizing a liquid helium cooled Cu:Ge detector. The initial pressure in the shock tube was varied from 30 to 600 torr and the temperature range covered was 1900-2300K. The monitored radiation was shown to be transparent over the range of densities employed. Effective first-order rate constants were evaluated from the logarithmic initial slopes of the radiation decay curves. The data was analyzed in the light of several modern unimolecular rate theories, yielding about 81 kcal as the endothermicity for the reaction SO2F2 + Ar to SO2F + F + Ar. Author (GRA)

N71-19947# Naval Research Lab., Washington, D.C.
A GENERAL SOLUTION TO THE ONE AND TWO

DIMENSIONAL MELTING USING A FINITE DIFFERENCE APPROACH

Stephen T. Hanley 23 Nov. 1970 22 p refs
(AD-716021; NRL-7200) Avail: NTIS CSCL 20/13

A general solution has been developed for the melting of solid materials, including a phase transition in the one- and two-dimensional models requiring a minimal amount of computer time and space and using a nonstandard finite difference approach. Accuracies of 1% in temperature profiles with time can easily be achieved. Both of these programs will handle a wide range of heating power levels and any desired thickness of liquid layer retained. Techniques developed in the one-dimensional case have served as helpful guidelines for the more complex two-dimensional burnthrough times and temperature profiles have aided in separating out the effects of radial heat conduction and geometry. Author (GRA)

N71-20049# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.

COMBUSTION RATE PROCESSES IN THE SECONDARY COMBUSTION OF AN AIR AUGMENTED SOLID PROPELLANT: EXPERIMENTAL FACILITY

D. S. Kushner, P. J. Goede, and J. G. Skifstad 20 Oct. 1970 46 p refs
(Contract DAAH01-69-C-1109)
(AD-716330; TM-70-7; RK-TR-70-15) Avail: NTIS CSCL 21/9

The report describes an experimental facility for the determination of the global combustion rates associated with the secondary combustion of an air-augmented propellant. The experimental method utilized a combustor in which a substantially premixed flow of particulate boron and air ignited and burned in a constant area duct. An optical system was designed for measurements of gas and particle temperatures at different axial positions along the duct. Instrumentation was also provided for measurements of the pressures and flow rates required for the formulation of a global combustion model. Author (GRA)

N71-20092*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESIGN STUDIES ON THE EFFECTS OF ORIENTATION, LUNATION, AND LOCATION ON THE PERFORMANCE OF LUNAR RADIATORS

Thomas Dallas, Anthony J. Diaguila, and James F. Saltsman Washington Mar. 1971 42 p refs
(NASA-TM-X-1846; E-4570) Avail: NTIS CSCL 20M

Lunar radiators which can be used for refrigeration, power generation, or component cooling are investigated. Graphical solutions of the design equations are presented. This expedites the procedure for approximating prime radiator areas for preliminary studies of lunar heat-rejection systems. The effective sink temperature for any given set of radiator conditions is readily obtained from the equations and graphs presented. An included problem for a 500-kilowatt power generation system gives 4000 and 6000 square feet for a polar and for an equatorial location, respectively. Author

N71-20119# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.

COMBUSTION RATE PROCESSES IN THE SECONDARY COMBUSTION OF AN AIR AUGMENTED SOLID PROPELLANT. PART 1: SPECTROSCOPIC MEASUREMENTS

P. J. Goede and J. G. Skifstad 30 Oct. 1970 74 p refs
(Contract DAAH01-69-C-1109)
(AD-716331; TM-70-8-Pt-1; RK-TR-70-16-Pt-1) Avail: NTIS CSCL 21/9

Spectroscopic measurements of the properties of the combustion products in a ramburner employing a boron-loaded propellant in the primary rocket are presented. The ramburner was designed to promote rapid mixing between the primary exhaust products and the secondary air, establishing nearly uniform combustion conditions across the duct. Variations of the properties of the secondary combustion products along the duct may be related to the global kinetics of the combustion reaction. The spectroscopic methods for the measurement of the gas and particle temperatures are discussed in the context of the observed flame emission spectra and the measured optical properties of the combustion products. Results of the study indicate that photometric measurements of gas temperatures, made just upstream of the exhaust nozzle of the ramburner, agree within 10% with bulk temperatures determined from experimental measurements of characteristic velocity. The corresponding photometric measurements of condensed phase temperatures were about 15% less than the bulk temperatures. Author (GRA)

N71-20184# Ballistic Research Labs., Aberdeen Proving Ground, Md.

TRANSIENT SURFACE HEATING OF LARGE SOLIDS SUBJECT TO SURFACE HEAT LOSS

Harold J. Breaux Oct. 1970 35 p refs
(AD-715954; BRL-1501) Avail: NTIS CSCL 20/13

Attention is focused on two classes of problems for the heating of semi-infinite solids subject to surface heat loss governed by Newtons Law of Cooling. A solution in the form of a definite integral is obtained for time independent sources having circular symmetry and for sources having symmetry about a line on the surface. These transient solutions generalize and extend a number of special case results previously described in the literature. For a uniform strip source, a steady state solution in the form of tabulated functions is obtained which is valid for all values of the space coordinates. Extensive graphs are included depicting the behavior of the dimensionless temperature as a function of the various dimensionless parameters for several of the most commonly used source functions. Author (GRA)

N71-20214*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THERMAL CONDUCITIVITY MEASUREMENTS OF A CANDIDATE VIKING HEAT SHIELD MATERIAL AFTER STERILIZATION, AND DURING EXPOSURE TO VACUUM, AND TO A SIMULATED MARTIAN ANTMOSPHERE

Lawrence R. Greenwood and Roy M. Fleming *In* NBS Space Simulation Oct. 1970 p 184–208 refs (See N71-20201 09-11)
(NASA-TM-X-66938) Avail: NTIS; SOD $5.25 CSCL 20M

The thermal conductivity of the proposed heat shield material, Martin SLA-561, was measured after sterilization and during exposure to vacuum and to a simulated Martian atmosphere (74.4 percent CO2, 12.8 percent N2, 12.8 percent Ar). In the first environmental sequence consisting of atmosphere, vacuum, and asimulated conductivity was measured in vacuum. After a 4-hour exposure to a 7 torr pressure in the simulated Martian atmosphere, the thermal conductivity increased 67 percent from the value measured in vacuum. The second environmental sequence consisted of measurements in the atmosphere, after sterilization and during exposure to vacuum and the simulated Martian atmosphere. The results showed that sterilization had no effect on the thermal conducitivity measured at atmospheric pressure nor on the changes measured in vacuum and in the simulated Martian atmosphere. Author

N71-20230# Martin Marietta Corp., Denver, Colo.

ESTABLISHMENT OF AN OPTIMUM DURATION FOR SPACECRAFT COMPONENT THERMAL VACUUM TESTS

W. L. Harvey *In* NBS Space Simulation Oct. 1970 p 473–485 refs (See N71-20201 09-11)
Avail: SOD $5.25

The durations of planetary space missions preclude performing component thermal vacuum tests which simulate the mission time period. Outlined is an approach which considers the probable effects of the thermal vacuum environment on the components and

their constituent materials. In general these effects are found to be related to the outgassing rate which is time and temperature dependent. A test cycle is proposed which considers this situation and utilizes any prior bake out heat exposure to reduce test duration to a reasonable period. Author

N71-20236# ARO, Inc., Arnold Air Force Station, Tenn. Aeroballistics Branch.

EXPLOSIVE OXIDATIONS INITIATED BY SIMULATED METEOROID PENETRATION INTO SPACECRAFT ATMOSPHERES

William H. Carden *In* NBS Space Simulation Oct. 1970 p 569–585 refs Sponsored in part by NASA (See N71-20201 09-11)

(Contract F40600-70-C-0002)

(NASA-CR-117142) Avail: NTIS; SOD $5.25 CSCL 20M

Hypervelocity impact tests were conducted in an evacuated range on target samples which simulated a S-IVB wall configuration since this stage is planned as the primary structure in the orbiting workshop program. The samples formed part of the wall of a large tank which contained an oxygen-rich atmosphere. The explosive oxidations which occurred inside the tank as a result of perforation were observed and the results were analyzed. The bare thermal insulation on the inside of the wall further enhanced the otherwise severe reaction which occurs with a metallic wall in the presence of enriched oxygen. Author

N71-20246*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ABLATIVE HEAT SHIELDS FOR PLANETARY ENTRIES: A TECHNOLOGY REVIEW

G. D. Waldberg and E. M. Sullivan *In* NBS Space Simulation Oct. 1970 p 751–812 refs (See N71-20201 09-11)

(NASA-TM-X-66946) Avail: NTIS; SOD $5.25 CSCL 20M

In discussing the work to date on planetary entry, two broad categories of research are considered: (1) entry into tenuous atmospheres; and (2) entry into the dense atmospheres of Venus and the giant planets. In each of these categories, atmospheric characteristics, entry velocities and modes, vehicle geometries, heating levels and candidate ablation materials are discussed. Present ground- and flight-test capabilities are summarized and compared with planetary- entry conditions. Particular attention is paid to coupled ablative-radiative phenomena. Author

N71-20247# Naval Ordnance Lab., White Oak, Md. Aerophysics Div.

ABLATION PHENOMENA IN SUPERSONIC LAMINAR AND TURBULENT FLOWS

E. M. Winkler, M. T. Madden, R. L. Humphrey, and J. A. Koenig *In* NBS Space Simulation Oct. 1970 p 813–835 refs (See N71-20201 09-11)

Avail: NTIS

Arc tunnel experiments using pipe specimens of TFE-7 examine the ablation of Teflon under supersonic laminar and turbulent boundary layers. Test conditions include Mach numbers of 2.3 and 3.0, supply pressures of 2 million N/sq m to 3 million N/sq m and supply temperatures of 2200 K to 5000 K. Experimental results are compared with computer predictions. In two laminar boundary layer tests, parallel striations appear; in all turbulent boundary layer tests, criss-cross striations appear. Author

N71-20248# Boeing Co., Seattle, Wash. Aerospace Group.

PREDICTION OF MECHANICAL EROSION OF CHARRING ABLATORS

Lauri H. Hillberg *In* NBS Space Simulation Oct. 1970 p 837–851 refs (See N71-20201 09-11)

Avail: SOD $5.25

A simple method has been developed for predicting the mechanical erosion of charring ablators exposed to an aerodynamic environment. The method requires the knowledge of two variables: the aerodynamic shear stress at the ablating surface and the surface temperature. Test data are used to obtain two empirical constants necessary for correlating the erosion recession rate in terms of these two variables. The empirical constants have been determined for phenolic cork, phenolic carbon, epoxy-novolac, and high density silicone rubber. Author

N71-20249# Naval Ordnance Lab., White Oak, Md. Aerophysics Div.

HEATING IN CRACKS ON ABLATIVE HEAT SHIELDS

E. M. Winkler, R. L. Humphrey, M. T. Madden, and J. A. Koenig *In* NBS Space Simulation Oct. 1970 p 853–877 refs (See N71-20201 09-11)

Avail: SOD $5.25

An experimental program has been carried out in an arc tunnel to study the effects of cracks in an ablative heat shield on substructure heating. The tests used a supersonic contoured nozzle with a Teflon duct attached to it. The ducts had transverse and longitudinal cracks machined into the surface. They were instrumented for pressure, temperature, heat transfer and skin friction measurements. The cracks were found to have pronounced effects on the ablative behavior. The heating is moderate under a laminar boundary layer, but can be catastrophic when the boundary layer is turbulent, depending upon the size and direction of the crack. Author

N71-20250*# Electro-Optical Systems, Pasadena, Calif.

APPARENT OPERATING LIMITS OF ARC HEATERS WITH RESPECT TO TOTAL ENTHALPY AND STAGNATION PRESSURE

R. Richter *In* NBS Space Simulation Oct. 1970 p 879–892 refs Sponsored in part by NASA and USAF (See N71-20201 09-11)

(NASA-CR-117144) Avail: NTIS; SOD $5.25 CSCL 20M

Arc heaters have been operated over a wide range of operating conditions; an apparent upper limit with respect to stagnation pressure and total enthalpy was found which could not be exceeded. This limit is not imposed by the enthalpy-pressure combination but is caused by the limit in total power input that can be achieved with the constricted arc heater. The failure or fast deterioration of arc heater components is found to be primarily due to high arc currents which are employed to heat the gas to maximum temperature. It is concluded that the enthalpy-stagnation limit of nonsegmented constricted arc heaters operating under similar constraints can be exceeded. Author

N71-20418*# Aerojet Liquid Rocket Co., Sacramento, Calif.

ANALYSIS OF THE LONGITUDINAL HIGH FREQUENCY STABILITY OF A STAGED COMBUSTION CYCLE, APPENDIX B

In its Stability Characterization of Advanced Injectors, Design Guide, Vol. 2 Feb. 1971 refs (See N71-20415 09-28)

Avail: NTIS HC $6.00/MF $0.95 CSCL 20M

The sensitive time lag theory in both combustors of a staged combustion cycle is applied to analyze longitudinal modes; no feed system effects are included. The primary and secondary combustors are coupled by including in the secondary analysis the flow oscillation generated in the primary combustor. As in other analyses using the sensitive time lag theory an n and tau curve for neutral stability are obtained. The only input parameters needed by the program which are somewhat obscure are the n and tau for the primary combustor and the specific acoustic admittance of the sonic secondary exhaust nozzle. Author

N71-20511*# Scripta Technica, Inc., Washington, D.C.

FLAMMABILITY OF AEROGELS OF ALUMINUM

MAGNESIUM ALLOYS [VOSPLAMENYAMOST AEROGELEY ALYUMINIYEVO MAGNIYEVYKH SPLAVOV]
V. G. Poyarkov et al NASA Mar. 1971 7 p refs Transl. into ENGLISH from Fiz. Aerodispersnykh Sistem (USSR), no. 2, 1970 p 128–134
(Contract NASw-2036)
(NASA-TT-F-14505) Avail: NTIS CSCL 21B

The self-ignition temperatures of aluminum magnesium alloys in the form of aerogels in thermally insulated ventilatable layers have been studied by the Kurnakov method for differential thermal analysis. Alloys were prepared from high purity magnesium and aluminum by double smelting in a high frequency induction furnace under a layer of flux. Thirteen specimens of ground alloy were prepared having a magnesium content of from 9.5 to 91.8% in order to cover all the transitions in the phase diagram. It is shown that self-ignition depends on the amount of heat produced by the exothermic oxygen-metal reaction in a unit of time and the conditions for heat transfer from the system into the environment. Author

N71-20523*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF SURFACE CATALYSIS ON HEAT TRANSFER TO SHUTTLE ORBITERS
Howard A. Stine 15 Mar. 1971 21 p refs
(NASA-TM-X-62016) Avail: NTIS CSCL 20M

The aerothermodynamic environment generated during much of the shuttle orbiter's entry flight consists of a flow of atoms and molecules. Oxygen is completely atomic and nitrogen is partly atomic and partly molecular. Two kinds of interactions of atoms with the shuttle surface are reviewed. First, the catalytic efficiency of the surface can change the incident heat transfer rate by factors of from two to three, depending upon whether the surface is chemically inert or chemically active, over the enthalpy range of peak heating. A corresponding surface radiation equilibrium temperature change of about 240 deg is calculated to be possible. Second, although information is scarce, indications are that oxidation rates of metals under attack by oxygen atoms can be one to two orders of magnitude greater than those corresponding to attack by oxygen molecules. Substantial improvement in shuttle operational capability, survivability, and longevity evidently can accrue if interaction of atomic oxygen with the shuttle surface can be suppressed. Author

N71-20524# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
EXPERIMENTAL STUDY OF HEAT TRANSFER FOR PARALLEL FLOW IN TUBE BUNDLES WITH CONSTANT HEAT FLUX AND FOR MEDIUM PRANDTL NUMBERS
Manfred Rieger (Ph.D. Thesis – Paris Univ.) 1969 115 p refs In FRENCH
(CEA-R-3599; EUR-3879) Avail: AEC Depository Libraries

Heat transfer parameters were determined experimentally in electrically heated tube bundles for turbulent flow parallel to the axis. The tubes were arranged in a pattern of equilateral triangles. The ratios of the distance between the axes of the tubes to their external diameter were 1.60 and 1.25 in the two test sections studied. The experiments were carried out with distilled water and with a mixture of 60% ethylene glycol and 40% water. The values obtained for the Prandtl numbers fell within the range from 2.3 to 18. The relation between the mean heat transfer coefficients and the friction factor in the tube bundles was found from the experiments. Author (NSA)

N71-20525# California Univ., Livermore. Lawrence Radiation Lab.
WALL TRACES OF DETONATION IN NITROMETHANE-ACETONE MIXTURES
P. A. Urtiew and A. S. Kusubov 6 May 1970 9 p refs Presented at the 5th Symp. on Detonation, Pasadena, Calif. 18–21 Aug. 1970 Submitted for publication Sponsored by AEC
(UCRL-72160; CONF-700803-8) Avail: NTIS

Wall traces of detonation in nitromethane-acetone mixtures are presented, and the technique of obtaining them is discussed. These records are compared to the carbon soot records of gaseous detonations, and the structure of the wave front is said to be similar in both phases of the explosive mixtures. Surface indentations found along the traces provide additional evidence that the traces were produced by localized peaks of pressure such as those associated with triple wave intersections. Complementary measurements of the wave velocity indicate that the process investigated is a full-scale detonation rather than a degenerate case of a low velocity type. Author

N71-20529# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
RATE-CONTROLLED PARTIAL-EQUILIBRIUM METHOD FOR TREATING REACTING GAS MIXTURES
James C. Keck and David Gillespie (Ill. State Univ.) Jan. 1971 16 p Sponsored in part by Ford Motor Co., *Its* Fluid Mech. Lab. Publ. No. 71-2
(Grant PHS-1-R01-AP-01228-01)
Avail: Issuing Activity

A rate-controlled partial-equilibrium method for treating reacting gas mixtures has been developed which is very much simpler than the usual technique of integrating the full set of rate equations. The method is based on the observation that a rate-controlling reaction is equivalent to a passive constraint on the gas and that the corresponding partial-equilibrium state can be calculated by minimizing the appropriate free energy function. An example illustrating the application of the method to the freezing of threebody reactions in an internal combustion engine is given. Author

N71-20531*# Techtran Corp., Glen Burnie, Md.
COMBUSTION OF MAGNESIUM PARTICLES IN RAREFIED AIR [GORENIYE CHASTITS MAGNIYA V RAZREZHENNOM VOZDUKHE]
V. A. Fedoseyev et al Washington NASA Mar. 1971 4 p refs Transl. into ENGLISH from Fiz. Aerodispersnykh Sistem (USSR), no. 2, 1970 p 98–101
(Contract NASw-2037)
(NASA-TT-F-13503) Avail: NTIS CSCL 21B

The results are evaluated of an experimental study of the combustion of large particles of magnesium during a change in the pressure of the ambient medium within the range from 100 to 760 mm Hg. It is found that the combustion time of a magnesium particle during an increase in the external pressure does not decrease monotonically, but passes through a maximum at pressures of the order of 400 mm Hg. Data concerning the length of the particle flame are obtained. Author

N71-20532*# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
THE INVESTIGATION OF CRITICAL PRESSURE BURNING OF FUEL DROPLETS Annual Report, 1 Jan. – 31 Dec. 1970
G. M. Faeth, C. Allison, G. S. Canada, and R. S. Lazar Jan. 1971 37 p refs
(Grant NGR-39-009-077)
(NASA-CR-72834) Avail: NTIS CSCL 20M

Measurements were made of steady burning temperatures, and the pressures required for the supercritical combustion of n-octane and n-decane droplets burning in air. Theoretical results were obtained with a low pressure model of droplet phase equilibrium as well as a high pressure model which accounted for dissolved gas in the liquid phase. Experimental results are described on the burning of hydrazine, MMH and UDMH droplets in the combustion

products of a flat flame burner at atmospheric pressure. These tests were conducted with ambient temperatures in the range 1650–2550 K and ambient oxygen concentrations up to 42% by mass. The design and construction of a high pressure flat flame burner apparatus is described. Experimental and theoretical results are also given for strand combustion of the monopropellants, ethyl nitrate, normal propyl nitrate, and propylene glycol dinitrate at pressures up to 85 atmospheres. A theory allowing for gas solubility in the liquid phase was found to give the best prediction of liquid surface conditions during these tests. Author

N71-20533*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

CONVERSION OF AN EXPERIMENTAL TURBOJET COMBUSTOR FROM ASTM A-1 FUEL NATURAL GAS FUEL

Francis M. Humenik Washington Mar. 1971 33 p refs

(NASA-TM-X-2241; E-6031) Avail: NTIS CSCL 20M

A side-entry turbojet combustor previously developed with ASTM A-1 fuel was redesigned to use natural gas fuel. The rectangular test section simulated a segment of an annular turbojet combustor. Five combustor liner configurations and two fuel nozzle geometries were evaluated. Natural gas fuel temperatures ranging from −259 to 1200 F were investigated. The test conditions were as follows: nominally atmospheric inlet pressure; inlet air temperature to 600 F; and diffuser inlet Mach numbers of 0.24, 0.30, and 0.37 corresponding to nominal reference velocities of 77, 100, and 120 ft/sec, respectively. The combustor configurations were designed to achieve combustor exit temperatures combustion efficiency and desirable radial exit-temperature profiles having low pattern factors were achieved with only minor combustor modifications. Ignition was readily obtained with natural gas temperatures of −235 F. Author

N71-20534*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

THERMODYNAMICS OF A HEISENBERG FERROMAGNET IN THE RANDOM PHASE APPROXIMATION

L. Flax [1971] 10 p refs Proposed for presentation at Intern. Congr. of Refrigeration, Washington, D.C., 27 Aug.–3 Sep. 1971; sponsored by Natl. Acad. of Sci.

(NASA-TM-X-52982; E-6203) Avail: NTIS CSCL 20M

The development of a formalism for the magnetic and thermal properties of the Heisenberg ferromagnet in an applied magnetic field is presented. By the use of Green's function theory the magnetization and susceptibility are determined in the random phase approximation. It is shown that the thermodynamic quantities can be expressed in analytical form for all temperatures, both above and below the Curie point. The object of this work is to evaluate the use of ferromagnetism in a refrigeration system. From the analytical results on magnetization and susceptibility, equations describing adiabatic and isothermal processes are presented. Magnetization and entropy are presented as functions of temperature and field. Author

N71-20542*# Rice Univ., Houston, Tex. Dept. of Chemistry.

THERMODYNAMIC PROPERTIES OF LIQUID METALS

John L. Margrave [1970] 10 p refs

(Grant NGL-44-006-001)

(NASA-CR-117032) Avail: NTIS CSCL 20M

Although liquid metals are susceptible to statistical mechanical description, current theory does not provide quantitative values for either heats of fusion or heat capacities of liquid metals at high temperatures. Only recently has a generally applicable experimental technique--levitation calorimetry--become available. At the moment, the very crude estimation rules: Delta S sub fus is approximately 2.2 to 2.3 calories per degree per mole, and C sub p(liq) is approximately 7-8 calories per degree per gram-atom are as good as the data and the theory. A table of consistent thermodynamic data for liquid metals has been assembled, including estimates for the many high-melting transition metals which have not yet been studied. Author

N71-20545# Sandia Corp., Albuquerque, N.Mex.

AIRBLAST FROM PROJECT TUGBOAT DETONATIONS

L. J. Vortman Nov. 1970 224 p refs Sponsored in part by AEC and Army Corps of Engr.

(SC-RR-70-541) Avail: NTIS

Four 1-ton and one 10-ton explosions of aluminized ammonium nitrate slurry were detonated in submerged coral limestone as calibration for three later explosions, each to consist of four 10-ton charges. Two of the later explosions were rows to provide an entrance channel for a small-boat harbor in Kawaihae Bay, Hawaii; the third explosion was a square array to excavate the berthing basin. The single charges produced ground-shock-induced peak overpressures that were five times those predicted on the basis of TNT detonations in dry soil, but were comparable to those of TNT detonations in water. Peak overpressures from venting gas were so small as to be barely discernible. Peak overpressures from the multiple-charge detonations showed little azimuthal variation and the row-charge peak overpressures were greater than those from single charges by approximately the predicted amounts. Peak overpressures from the four-charge square array were more than had been predicted. Positive impulses from multiple charges were greater than those from single charges by about the number of charges. Maximum probability of glass breakage based on measured peak overpressures was less than 4 panes per thousand, but no blast damage actually resulted. Author

N71-20564# Commissariat a l'Energie Atomique, Cadarache, (France). Centre d'Etudes Nucleaires.

HYBRID COMPUTATION OF A HEAT EXCHANGER [ETUDE D'UN ECHANGEUR DE CHALEUR PAR CALCUL HYBRIDE]

Herve Chareton, Jean-Louis Corriol, and Pierre Poulard 1970 9 p ref In FRENCH Presented at the Conf. on Hybrid Computation, Munich.

(CEA-CONF-1592; CONF-700826-4) Avail: AEC Depository Libraries

A sodium-water counterflow heat exchanger was studied. It consisted of three parts: (1) an evaporator, (2) an economizer, and (3) a superheater and a resuperheater. In the sodium circulation, there is a joint between the exit of the superheater and the resuperheater before the economizer, but the water circulation between economizer-evaporator and superheater and resuperheater may be considered independent. In the resuperheater there is only dry vapor, although the three phases of water are possible in the economizer and superheater. Two variables are involved, thus the analysis may be made in space or in time. The spatial analysis using the series method (or the Continuous Space, Discrete Time C.S.D.T) was considered to be the best. At a given instant a single system of equations represents the exchanger. From the point of view of phase and thermodynamic functions the circuits are interchangeable. The exchange coefficients are also studied in this way. This model is considered to be an important step in the development of hybrid programs for vapor generator calculations. NSA

N71-20593*# Mechanical Technology, Inc., Latham, N.Y. Research and Development Div.

EVAPORATIVE PROCESSES IN SUPERHEATED FORCED CONVECTIVE BOILING

J. H. Vohr Dec. 1970 174 p refs

(Contract NASw-1705)

(NASA-CR-117046; MTI-70-TR-15) Avail: NTIS CSCL 20M

The various vaporization processes subsequent to incipient boiling in the forced convective flow of a superheated liquid are considered. In particular, approximate derivations in closed form for

the growth of a submerged single vapor bubble and for the propagation of a large central void in a forced convective flow are carried out. In addition, general expressions for the vapor generation rate are constructed not only for above two processes but also for the annular and the dispersed flow regimes. Author

N71-20899# General Electric Co., Pleasanton, Calif. Nucleonics Lab.
A THERMODYNAMIC DATA PROGRAM, INVOLVING PLUTONIA AND URANIA AT HIGH TEMPERATURES Quarterly Report, 1 May - 31 Jul. 1970
E. A. Aitken and S. K. Evans Oct. 1970 12 p refs
(Contract AT(04-3)-189)
(GEAP-12133; Rept-3325-NL-15; QR-12) Avail: NTIS

Results of experiments directed toward understanding plutonium segregation in urania-plutonia solid solutions and in fast reactor environments through a knowledge of its thermodynamic behavior are reported. The progress of several experiments which have a bearing on plutonium segregation is described. NSA

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N71-19397# National Academy of Sciences-National Research Council, Washington, D.C.
VISUAL FACTORS IN TRANSPORTATION SYSTEMS
1969 135 p refs Presented at the Proc. of Spring Meeting, NAS-NRC Comm. on Vision, 1969
(PB-196014) Avail: NTIS CSCL 13F

Contents: Visual problems of truck and bus drivers; Visual problems in automobile driving; Factors in visibility and legibility of highway signs and markings; Requirements for automobile exterior lighting; Factors in highway lighting; Selected visual problems of an airline pilot; Visual problems of the air traffic controller; Some display concepts in air traffic control; The helicopter in high density traffic; Measurement of height and distance information provided pilots by the extra-cockpit visual scene; Visual illusions in aircraft accidents. GRA

N71-19697# Michigan Univ., Ann Arbor. Inst. for Social Research.
CONFLICT STRATEGIES RELATED TO ORGANIZATIONAL THEORIES AND MANAGEMENT SYSTEMS Technical Report, 1 Oct. 1970 - 1 Oct. 1971
Rensis Likert and David G. Bowers Dec. 1970 35 p refs
(Contract N00014-67-A-0181-0013)
(AD-716018) Avail: NTIS CSCL 5/10

The report describes in theoretical terms the relevance of management systems theory to the problem of conflict management. Possibilities for resolving conflict constructively are seen as residing in the use of an interaction influence system characterized by a participative-group structure. Author (GRA)

N71-19698# National Planning Association, Washington, D.C.
CASE STUDIES OF GOVERNMENT COOPERATION IN FOUNDING NEW INDUSTRIES: WITH IMPLICATIONS FOR MARINE RESOURCE DEVELOPMENTS Technical Report, 1958 - 1970
S. Sterling McMillan and Miller B. Spangler Oct. 1970 133 p refs
(Contract NSF C-468)
(PB-196038) Avail: NTIS CSCL 05C

Contents: The federal role in the development of the synthetic rubber industry; The growth of civilian atomic energy; The Communications Satellite Corporation. GRA

N71-19922# National Science Foundation, Washington, D.C.
IMPACT OF CHANGES IN FEDERAL SCIENCE FUNDING PATTERNS ON ACADEMIC INSTITUTIONS, 1968 - 1970
Dec. 1970 82 p
(NSF-70-48) Avail: SOD $0.75

The replies to two surveys, undertaken in spring 1969 and 1970, show that, while total expenditures for research and education in the sciences had increased over the 2-year period covered, these expenditures had not kept pace with the combined increases in general enrollment and higher costs. Expenditures from non-Federal funds compensated at least in part for the leveling trend of Federal funding. Private institutions, in general, and the largest public institutions reported the most serious curtailment of monies for science, and of Federal funds in particular. Large numbers of academic officials reported impairment of graduate programs and research, curtailment of facilities and equipment, adverse career and employment impacts, administrative difficulties, and lowered morale of students and science faculty. New or developing institutions and departments frequently reported problems in meeting planned goals as a result of changes in Federal funding. Author

N71-19939# ARIES Corp., McLean, Va.
INTERFERON SCIENTIFIC MEMORANDA: A NEW COMMUNICATION MEDIA FOR INCREASING THE EFFICIENCY AND EFFECTIVENESS OF SCIENTIFIC RESEARCH Annual Progress Report, 1970
1 Mar. 1970 31 p
(Contract PH-43-68-854)
(PB-195722) Avail: NTIS CSCL 05B

The desirability of increasing the speed of informal communications of information among investigators in well defined areas of a scientific discipline was established. The 'Interferon Scientific Memoranda (ISM)' is a part of the NIAID feasibility project responding to this increased need for communication. The ISM is an informal communication for investigators on interferon. In the first year of operation, the photoduplication medium using the mails as a communication channel was established as the vehicle for this rapid informal communication system. The test program proved through the elimination of unnecessary duplication of experiments, in improvements in design of experiments, in improvement in design of experiments, and in savings in research time plus animals, supplies and facilities. The progress of its second year of operation is discussed. Author (GRA)

N71-19940# Cornell Univ., Ithaca, N.Y. Materials Science Center.
[SUMMARIES OF THE 1969/1970 RESEARCH PROGRAMS OF MEMBERS OF THE MATERIALS SCIENCE CENTER] Annual Technical Progress Report, 1 Jul. 1969 - 30 Jun. 1970
1 Dec. 1970 151 p refs
(Contract ARPA SD-68)
(AD-716469) Avail: NTIS CSCL 11/7

Summaries of the 1969/1970 research programs of the individual members of the Materials Science Center, arranged alphabetically by member, are presented on the following pages. Where appropriate, a members total research program is subdivided into separate research projects, which form distinct units characterized by specific titles. These summaries contain the names of the postdoctoral research associates and graduate student research assistants associated with each Member, as well as a list of reports, publications (published or accepted for publication during the report period) and theses submitted for Ph.D. or M.S. degrees during 1969/1970. The main support for each individual research project is indicated. Author (GRA)

N71-19941# Defense Documentation Center, Alexandria, Va.
THE FUTURE OF INDEXING AND RETRIEVAL VOCABULARIES
Paul H. Klingbiel Nov. 1970 33 p refs
(AD-716200; DDC-TR-70-4) Avail: NTIS CSCL 5/2

The role of formal, controlled vocabularies for indexing and retrieval is contrasted with the use of natural language for these activities. The following credo is advanced for large central information processors as appropriate to the 1970s. (a) Highly structured controlled vocabularies are obsolete for indexing and retrieval. (b) The natural language of scientific prose is fully adequate for indexing and retrieval. (c) Machine-aided indexing of natural language is within the state of the art. (d) Natural language retrieval can be conducted on line if the request can be stated in a phrase or a sentence. Author (GRA)

N71-19942# Polytechnic Inst. of Brooklyn, N.Y. Microwave Research Inst.
[RESEARCH ACCOMPLISHED UNDER THE AEGIS OF THE MICROWAVE RESEARCH INSTITUTE] Progress Report, 15 Sep. 1969 – 14 Sep. 1970
Arthur A. Oliner and Jerome Fox Nov. 1970 498 p refs
(Contract F44620-69-C-0047)
(AD-715970; PIBMRI-R-452.35-70; AFOSR-70-2513TR; PR-35) Avail: NTIS CSCL 20/14

The report summarizes research accomplished under the aegis of the Microwave Research Institute and reflects the impact of the Joint Services Electronics Program on the research activities of faculty and students of the participating departments of the Institute. The program covers a broad spectrum ranging from basic theoretical physics, mathematics, and engineering, to experimental investigations involving basic measurements, development of devices, and materials. The report is compiled under seven headings: Electromagnetics and Waveguide Techniques; Quantum Electronics and Optics; Plasma Physics and Electronics; Solid State and Materials; Control Theory and Computer Science; Communications and Information Processing; Systems and Networks. Author (GRA)

N71-19948*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF AUTOMOTIVE THERMAL REACTORS ON A V-8 ENGINE
Robert R. Hibbard, Cleveland O'Neal, William E. Riewaldt, and Alfred W. Young Washington Mar. 1971 14 p refs
(NASA-TM-X-2230; E-6081) Avail: NTIS CSCL 21G

Two exhaust manifold thermal reactors, one experimental and one of proven design, were compared with a standard-manifold-secondary-air system for the control of hydrocarbon and carbon monoxide emissions. Tests were run at various speeds and loads on an unmodified V-8 engine that operated at relatively lean (high air to fuel ratio) conditions. Under these lean conditions there was little difference in the effectiveness of the three systems, and none approached the requirements for hydrocarbon control proposed for 1975. The reason is that, except at one high load condition, both reactors operated at temperatures well below the 1000 K (1340 F) that kinetic analysis suggests as a minimum operating temperature. A few tests were also run with one of the reactors using enriched (lower air to fuel ratio) carburetion. Very low concentrations of hydrocarbons were found under these conditions. Author

N71-20114*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN ECONOMIC ANALYSIS OF FUTURE SHORT-HAUL TRANSPORTATION
George C. Kenyon, Thomas L. Galloway, and Hubert M. Drake Washington Mar. 1971 62 p refs
(NASA-TM-X-2228; A-3727) Avail: NTIS CSCL 05C

A simplified economic analysis has been made of one transportation mission: intercity short-haul business passenger-travel. The analysis includes both air and ground transportation modes for 1968 based on current mode characteristics, and for 1975 and 1982 based on projected characteristics for two assumed levels of R&D. The effects of changes in the transportation mode and interface characteristics are investigated. The simplified approach allowed a qualitative assessment of the relative merits of transportation modes. Specifically, the results for 1968 indicated that the auto, bus, and subsonic jet were competitive while the train was not. The helicopter could be competitive at ranges between 50 and 150 miles for time values above $5/hour. The light aircraft was particularly attractive for multiple travelers. Results for 1975 and 1982 indicated that: (1) the auto will remain the major mode for short distances; (2) the bus will remain competitive at low time values; (3) the high speed train will not be competitive unless heavily subsidized; and (4) the STOL transport will be a major transportation mode until it is replaced by the VTOL. An intensive level of R&D effort will be required to produce a competitive VTOL transport by 1982. The light aircraft mode, particularly with STOL performance and multiple travelers, appears very promising. Author

N71-20123# Loughborough Univ. of Technology (England). Dept. of Transport Technology.
PROJECT DESIGN OF LONG-RANGE ANTI-TANK WEAPON: DESIGN STUDY FOR WEAPON SYSTEM DESIGN COURSE, 21 APRIL – 13 MAY 1969
P. W. Sherman, W. Lavender, B. Taylor, A. G. A. White, and A. Moore, comps. 13 May 1969 54 p
(TT-7005) Avail: NTIS

The course for designing a long-range antitank/bombardment weapon system is presented. The design areas of target location, homing, warhead, trajectories, propulsion, midcourse guidance, communication, control, power supplies, and structure are discussed for a postulated requirement to seek out and immobilize enemy tanks at ranges between 5 and 20 km with a twenty-four hour all-weather capability. F.O.S.

N71-20141*# Indiana Univ. Foundation, Bloomington. Aerospace Research Applications Center.
[ABSTRACT AND DOCUMENT REPRODUCTION] Final Report, 1 Oct. 1969 – 30 Sep. 1970
Joseph Di Salvo 15 Oct. 1970 21 p
(Contract NSR-003-086)
(NASA-CR-117176) Avail: NTIS CSCL 05B

Complete sets of abstracts on individual cards from 162 issues of the USGRDR abstract journal were produced and sent to the six NASA regional dissemination centers (RDC). The establishment and operation of a document reproduction service for the six RDC is described. Author

N71-20526*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AN ONLINE INTERACTIVE BOOK-LIBRARY-MANAGEMENT SYSTEM
Edward E. Shumilak Washington Mar. 1971 42 p refs
(NASA-TN-D-7052; MSC-S-259) Avail: NTIS CSCL 05B

The book-library-management system which was designed to perform rapidly all circulation-desk bookkeeping duties at the Technical Library of the Manned Spacecraft Center, Houston, Texas is described. The system and its associated computers and remote-console input/output devices have produced noticeable improvement in various library operations by decreasing the number of errors, eliminating some operations, and freeing the library technician for more important work by decreasing the number of manual operations. In addition, less large-scale computer time is required to generate the necessary periodic statistical and inventory reports for management and control purposes. Author

N71-20527* National Aeronautics and Space Administration, Washington, D.C.
INTERNATIONAL PROGRAMS Fact Sheet
Mar. 1971 19 p
(NASA-TM-X-66907) Avail: NASA Scientific and Technical Information Facility, P. O. Box 33, College Park, Md. 20740

A summary of NASA's international activities from 1958 to 1970 is presented. The cooperative aerospace projects, including experiments and research are listed with the various countries concerned. F.O.S.

N71-20565# National Science Foundation, Washington, D.C.
NATIONAL PATTERNS OF R AND D RESOURCES. FUNDS AND MANPOWER IN THE UNITED STATES, 1953 - 1971
Dec. 1970 46 p refs
(NSF-70-46) Avail: SOD $0.50

Data on the support and performance of research and development in the United States are presented. The data show the pattern of utilization of national scientific and engineering resources, both funds and manpower, among the various sectors of the economy. Historical trends and interrelationships for all types of research and development are included. Author

N71-20566# Committee on Labor and Public Welfare (U.S. Senate).
ENVIRONMENTAL QUALITY EDUCATION ACT
Washington GPO 1970 456 p refs Hearings on S. 3151, S. 3237, and S. 3809 before Comm. on Labor and Public Welfare, 91st Congr., 2d Sess., 19 - 20 May 1970
Avail: Subcomm. on Education

A Congressional Bill to promote improved understanding of policies and support of activities designed to enhance environmental quality and maintain ecological balance is presented. The Bill contains the following provisions: (1) authorize the U.S. Commissioner of Education to establish educational programs to encourage understanding of policies and support of environmental improvement activities, (2) provide grants to conduct special educational programs on ecological-environmental education, and (3) provide fellowships for persons preparing for environmental careers. Author

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